ENGINEERING

THE UNIVERSITY
OF MICHIGAN
DEC 21 1961
ENGINEERING
duction LIBRARY

**tting Fluids and their
formance**

earch Report:
**Ultrasonic Flowmeter
Industry**

ecial Article:
**e Fight against
dustrial Fire**

Home:
oke Trouble

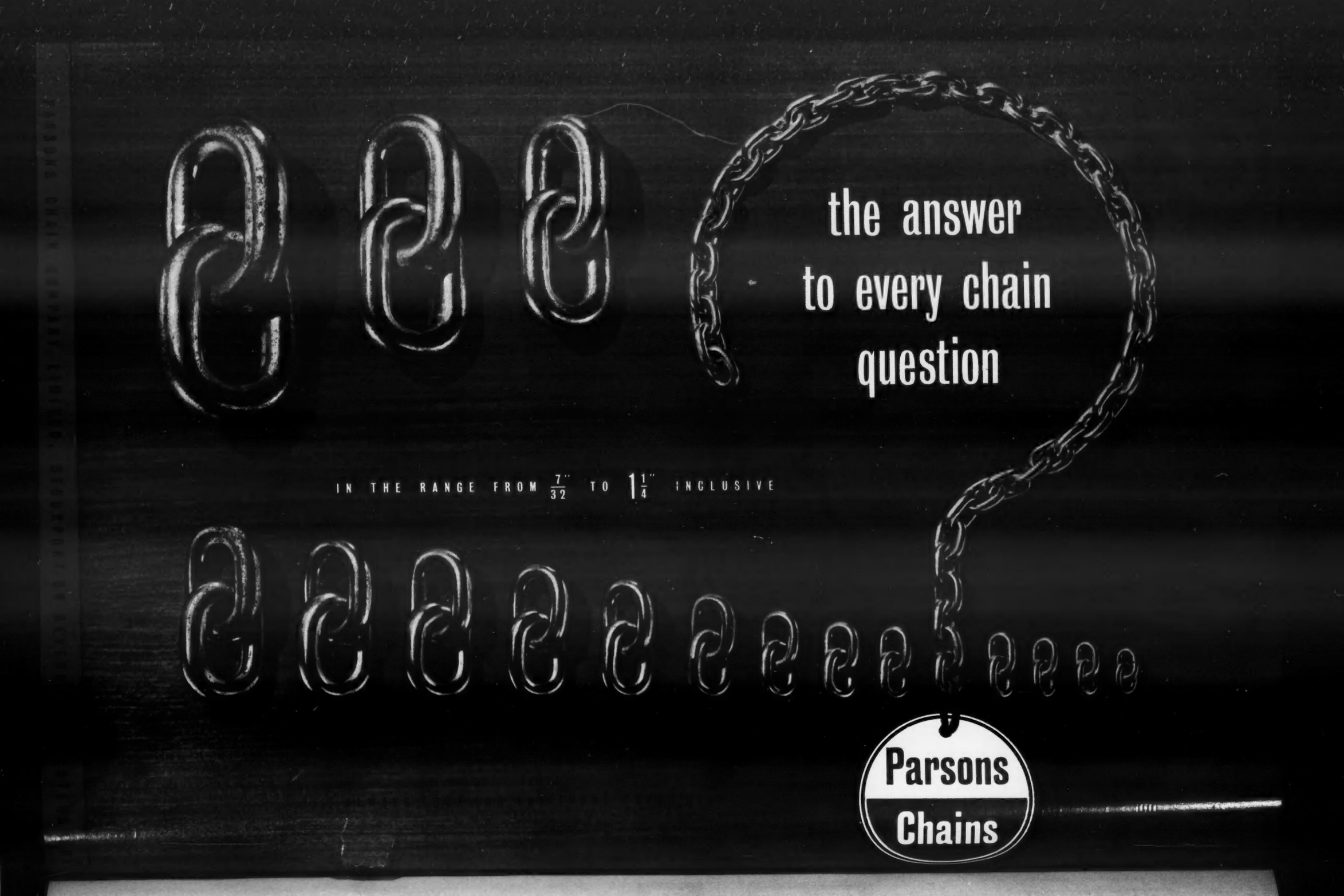
oduct Profile:
**e Two-Rail
rnby-Dublo Train**

nagement:
**sic Research into
e Human Factor**

sign:
**Gas-Turbine for
gh Temperatures**

tals and Materials:
**of Anti-Vibration
ber Mountings**

-Aligning Bearings


the answer
to every chain
question
IN THE RANGE FROM 7/32" TO 1 1/4" INCLUSIVE
Parsons
Chains

1 December 1961

Vol. 192 No. 4989

Founded in 1866

ENGINEERING

PUBLISHED EVERY FRIDAY

36 Bedford Street London WC2 England Telephone : Temple Bar 3663

Contents

698 Design

Bogie Development on British Railways

Thermal Storage Valve, Ferry Can Handle Outsize Commercial Vehicles

A Gas-Turbine for High Temperatures
By A. F. Elkouh, C. L. Sollenberger and D. McFarlin

705 Construction

Pipe Strains after Laying, Six Lane Motorway on Reclaimed Land, Glulam Beams 100 ft Long, Soil Mechanics on NE Region, Composite Construction in Floors and Walls, Waterproof Sandwiches for Flat Roofs, Aluminium Interlocking Facing System

Economic Quarrying for a Road, Minimizing Electrical Costs in Factory Buildings, Automatic Batching Plant for Pre-Mixed Concrete

Economic Possibilities of Cold-Formed Steel Sections, More Lightweight Concrete from Pulverized Fuel Ash, Dexion Used in Grandstand Construction, Safety Booklet for Site Supervisors, New Seal Creeps Horizontally, Building Scheme Completed Early

710 New Plant and Equipment

Factory Equipment Exhibition:

Mobile Steam Generator, Elevator Truck, Factory Marking Machines, Tube Cleaner and Burnisher, Air Sander

Steam Cleaner, Industrial Vacuum Cleaner, Storage and Filing Cabinets, Ball and Roller Linear Bearing, Micro Measuring Instrument, Automatic Coal-Fired Boiler

714 Metals and Materials

Uses of Anti-Vibration Rubber Mountings

Plastic-Coated Steel Floorplates, Ductile Cobalt Strip Available from Canada, Cover Protection for Glass Fibre Insulation, Densified Wood Collector Plate, Chromating Processes for Zinc and Plate, Lightweight Air Ducting, Plastic Dough Horn for Fire Extinguisher

716 Production

Cutting Fluids and Their Performance
By I. S. Morton and A. L. H. Perry

725 Research

Research Report:

An Ultrasonic Flowmeter for Industry

Preparing for Satellite Communications, New Application for Thermoelectricity, Nuclear Generator for Satellites, Saline Water Purification, Constant Rate Stroboscope Unit, Measurement of Ships' Speed by Radar

697 Impact

704 Human Element

713 Companies

721 Marketing

701 Automobile Review

A Finance House Goes Motor Racing

708 Special Articles

The Fight Against Industrial Fires

712 Management

Basic Research into the Human Factor

722 Product Profile

The Two-Rail Hornby-Dublo Train Set

728 At Home

Smoke Trouble

702 Plain Words

By Capricorn

702 Letters to the Editor

Air Travel for Durgapur Steelworks Model
H. Clarkson

Designers with a Fresh Look
H. N. D'Aeth

Speaking for the Professional Engineer
James A. Harley

Governor for Diesel Fuel Pump
C. Herlin

703 Events in Advance

718 Publications

On the Shelf
By Frank H. Smith

Books Reviewed:

Mine Ventilation and Air Conditioning

The Steel Industry, 1939-1959

South African Mining and Engineering Year Book, 1960-61

Vibrations from Blasting Rock

Spring Design

Trade Publications and New Books

Cover Picture

These self-aligning bearings are ring oiled and water cooled. The self-aligning feature is obtained from a spherical seating which permits a small movement in the sleeve within the housing. The photograph shows the water cooling pipes being assembled prior to fitting the covers. (*Nurnberg photograph for* ENGINEERING)

Subscription Rates: Editorial page 728 **Index to Advertisers: Overleaf** **Appointments Advertisements: Face Editorial page 712**

Advertisers in 'Engineering' this week

	PAGE
Access Equipment, Ltd.	42
Aerex, Ltd.	25
Allen, Edgar, & Co., Ltd.	47
Allen, W. H., Sons & Co., Ltd.	58
Allspeeds, Ltd.	20
Armstrong Stevens & Son, Ltd.	10
Associated Electrical Industries, Ltd. Transformer Division.	41
Astley Industrial Trust, Ltd.	44
Atlas Copco A.B. (Sweden).	22
Auchterlonie, C., & Co., Ltd.	26
Bailey, Sir W. H., & Co., Ltd.	9
Beresford, Jas., & Son, Ltd.	55
Booth, Joseph, & Bros.	55
Bostock & Bramley, Ltd.	23
British Ermeto Corp., Ltd.	7
British Railways.	28
British Steam Specialties, Ltd.	55
British Twin Disc, Ltd.	4
Brown, David, Corpn. (Sales), Ltd.	45
Brown, E. G., & Co., Ltd.	24
Butterfield, W. P. (Engineers) Ltd.	48
Clyde Crane & Booth, Ltd.	55
Clyde Crane & Engineering Co.	55
Cohen, G., Sons & Co., Ltd.	11
Colt Ventilation, Ltd.	21
Conveyor & Elevator Co. (1936) Ltd.	10
Cox & Danks, Ltd.	4
Davidson & Co., Ltd.	16
Dawson & Downie, Ltd.	26
E.N.V. Eng'g. Co., Ltd.	57
Edwards, F. J., Ltd.	15
"Engineering" Reprints	55
English Electric Co., Ltd. Hydro-Electric Division	43
Falk, Stadelmann & Co., Ltd.	56
Fearnehough, W., Ltd.	10
Firth, Thos., & John Brown, Ltd.	19
Ford Motor Co., Ltd.	52
Fordsmith, H., Ltd.	24
Frank, Chas., Ltd.	26
General Descaling Co., Ltd.	46
Glover, W. J., & Co., Ltd.	8
Goodyear Tyre & Rubber Co. (G.B.) Ltd.	36
Grafton Cranes, Ltd.	52
Guest Keen & Nettlefolds (Midlands) Ltd.	14
Heap, J., & Co., Ltd.	15
Hingley, N., & Sons (Netherton) Ltd.	28
Hood, R., Haggie & Son, Ltd.	23
Ionic Plating Co., Ltd.	34
John Bull Rubber Co., Ltd.	17
Keelavite Hydraulics, Ltd.	40
Lafarge Aluminous Cement Co., Ltd. 12 &	54
Leigh, W. & J., Ltd. *Wrapper*	III
Levy, B., & Co. (Patterns) Ltd.	15
Lucas Industrial Equipment, Ltd. *Wrapper*	VI
Lysaght-DeVilbiss Division of J. Lysaght's, Ltd.	18
McGraw-Hill Publishing Co., Ltd.	4
Markland Scowcroft, Ltd. *Wrapper*	IV
Mason, E. N., & Sons, Ltd.	5
Monk, A., & Co., Ltd.	35
Moore & Wright (Sheffield) Ltd. *Wrapper*	VII
Morgan Refractories Ltd.	30
Moss Gear Co., Ltd. *Wrapper*	VIII
Newbury Diesel Co., Ltd.	15
Oxford University Press.	4
Parks Forge, Ltd.	26
Parsons, C. A., & Co., Ltd	38
Parsons Chain Co., Ltd. *Wrapper*	II
Paterson Eng'g. Co., Ltd. *Wrapper*	III
Peglers, Ltd.	53
Pilot Works, Ltd. *Wrapper*	VII
Pinchin Johnson & Co.	29
Positive Lock Washer Co., Ltd.	15
Pye-Ling, Ltd.	6
Ratcliffe, F. S. (Rochdale) Ltd.	48
Regent Oil Co., Ltd.	37
Reynolds Tube Co., Ltd.	31
Robson, G., & Co. (Conveyors) Ltd.	32
Sankey Green Wire Weaving Co., Ltd.	33
Saunders Valve Co., Ltd.	24
Scriven Machine Tools, Ltd.	26
Shell-Mex & B.P., Ltd.	39
Simmonds Aerocessories, Ltd.	51
Skinningrove Iron Co., Ltd.	50
Sturtevant Engineering Co., Ltd.	13
Sumo Pumps, Ltd.	42
Sunbeam Anti-Corrosives, Ltd.	9
T.A.L. Numatics, Ltd.	48
Talbot Tool Co., Ltd.	32
Taylor, B. & R.	44
Taylor, F., & Sons (Manchester) Ltd.	27
Taylor & Hubbard, Ltd.	46
Terry, H., & Sons, Ltd.	33
Vickers Sperry Rand, Ltd. *Wrapper*	V
Vulcan Boiler & General Insurance Co., Ltd.	32
Ward, Thos. W., Ltd.	49
Wellman Bibby Co., Ltd.	50
Wellman Smith Owen Eng'g. Corpn., Ltd.	36
Wells, A. C., & Co., Ltd.	24
White, R., & Sons (Engineers) Ltd.	2
Whittle, T., & Sons, Ltd.	52
Wiseman, A., & Co., Ltd.	31

'Engineering' Appointments Section (inside Editorial Section)

	PAGE
Incandescent Heat Co., Ltd.	3
Loewy Eng'g. Co., Ltd.	3
Mullard Southampton Works.	3
Northern Nigeria, Govt. of	1
Power-Gas Corpn., Ltd.	1
Sutcliffe, R., Ltd.	1
Tube Investments, Ltd.	1
Turner & Newall, Ltd.	1
Vickers-Armstrongs (Engineers), Ltd.	1

Classified: Trade & Technical

	PAGE
Edwards, F. J., Ltd.	3 & 4
General Electric Co., Ltd.	4
Glasgow Corpn.	4
Government Surplus Stores	3
Institute of Nuclear Engineers	3
Johnson, S., & Sons (London), Ltd.	4
K.E.N.T. Machinery & Eng'g. Co.	3
Kenffel & Esser Co.	3
Marks & Clerk	1
N.P.P.C., Ltd.	1
Norris Bros., Ltd.	1
Nottingham, City of	1
Plint & Ptns., Ltd.	1
Research Engineers, Ltd	1
Steward, J. H., Ltd.	1
Welsh College of Advanced Technology	1
Whiteley, Ferris & Pickridge	1

Sales and Valuations

	PAGE
Butcher, Henry & Co.	2
Fuller Horsey Sons & Cassell.	2
Farmer, Leopold & Sons	2
Goddard & Smith	2
Knight Frank & Rutley	2

Company Meeting

Toledo Woodhead Springs, Ltd. 1

RAILS, SLEEPERS & EVERYTHING FOR SIDINGS.
CONSTRUCTION & MAINTENANCE. Write to WHITES of Widnes
ESTABLISHED 1869
R. WHITE & SONS (Engineers) LTD., P.O. BOX 2, WIDNES, LANCS.
Telegrams: "RAILS, WIDNES". Telephone: WIDNES 2425 (Three lines)

SALES AND VALUATIONS
LEOPOLD FARMER & SONS
conduct
AUCTION SALES
and
VALUATIONS
OF PLANT, MACHINERY AND INDUSTRIAL PROPERTIES
46 GRESHAM STREET, LONDON, E.C.2.
Telephone: MONarch 3422 (10 lines) Telegrams: Sites, London
G 6

SALES AND VALUATIONS
HENRY BUTCHER and Co.
Auctioneers, Valuers and Surveyors
Specialising in the
SALE & VALUATION of
Engineering & Allied Works
Plant & Machinery
FACTORY AGENTS
73 CHANCERY LANE, LONDON, W.C.2.
HOLBORN 8411 (8 LINES)
G 4

TRADE AND TECHNICAL

SALES AND VALUATIONS
GODDARD & SMITH
For the Sale & Valuation of all types of Industrial Premises Plant & Machinery
GODDARD & SMITH
22 King Street
St. James's, S.W.1.
Tel: WHI 2721 (20 lines)
G 1

EXPERIMENTAL
DEVELOPMENT WORK
PROTOTYPES
SPECIAL PURPOSE MACHINES
PRECISION ENGINEERING FROM SMALL SCIENTIFIC INSTRUMENTS TO MACHINES AND APPARATUS OF SEVERAL TONS
A.I.D. AND A.R.B. APPROVED
RESEARCH ENGINEERS LIMITED
ORSMAN ROAD, SHOREDITCH, N.1.
SHO 7811/7815
G 900

FULLER HORSEY
SONS & CASSELL
Industrial Valuers
Surveyors
Auctioneers
and
Estate Agents
since 1807
10 LLOYD'S AVENUE, LONDON, E.C.3
ROYAL 4861
G 3

Knight Frank & Rutley
Industrial Surveyors
20 Hanover Square
London W.1
MAYfair 3771. (20 lines)
G5

CONSULTANTS AND EXPERIMENTAL WORK
NORRIS BROS. LTD.
53 VICTORIA ST., LONDON, S.W.1
Tel: ABBey 6132
and at Burgess Hill, Sussex
Specialists in
RESEARCH, DESIGN AND DEVELOPMENT
throughout the whole Engineering Industry
G 900

PLINT & PARTNERS LTD.
Blakes Road, Wargrave, Berks.
Tel: Wargrave 427
MECHANICAL ENGINEERS
Investigate research problems and design and manufacture equipment for
RESEARCH & DEVELOPMENT
INSTRUCTION
G 771

ENGINEERING Impact

of a Research Stimulus to Shipbuilding

With the news that an organization to be known as the British Ship Research Association is to be set up to bring together the existing research activities of the British Shipbuilding Research Association and Pametrada (Parsons and Marine Engineering Turbines Research and Development Association), hopes may be raised justifiably high for the future of British marine engineering development.

Research is a good thing in itself in all conscience; but it is even better if it promotes the feeling throughout the industry it serves that it is in fact a *power* of good, inspiring production and showing the way into the future. As well as giving the British Shipbuilding Research Association their own laboratories as such for the first time (at Wallsend, Northumberland) this move will extirpate the internal uncertainties which have beset Pametrada in its previous function of covering both research and design.

The research section will now be free to follow investigations in new and established directions, and on a bigger scale, in the new combine. Although BSRA tell ENGINEERING that it is too early to be specific about future plans, production research, a recent departure in the field, will continue to be developed. The design side of Pametrada will be carried on under that name as a separate unit financed by industry.

Britain's shipbuilding has perhaps been in need of increased morale for some time—and this is due not least to its own awareness of its traditions as a great world industry in times when overseas competition keenly challenges that reputation. It was, after all, first among the shipbuilding industries of the world to have its own research organization. The demands made on its pride of place in these days when courage is born of technical superiority must be passed right back to the guiding lights themselves—that they should shine with conviction, and unwaveringly—from one of the largest of the industrial research associations of this country.

Transport Turmoil

The Transport Bill, which has recently had its second reading in the House of Commons, has revived the old feuds between road, rail, sea and air.

Changes in government bring changes in policy to transport, and changes in the economy and in technical development must inevitably be reflected in changes in policy.

Transport is fair game for criticism at any time, yet what other country gives such excellent services to its commuters as, say, the suburban trains of the Southern Region of British Railways; or —forgetting the inadequate number of good trunk roads—what country has such a comprehensive network of second class roads?

It is the technical development of road transport, as well as the commercial factors, which has largely contracted the figures for freight carried by the railways. So far this year British Railways have handled about 20 per cent less tonnage than in 1953, and worked almost 25 per cent fewer ton-miles. Likewise, coastal shipping—which takes a justifiably pessimistic view of its future—already suffering from declining tonnage largely because the traffic has been transferred to the railways, fears a further reduction if the Transport Bill goes through unamended. Coastal shipping suffers the disadvantage of not directly controlling the handling of the cargoes at either end, as well as taking longer on the journey. In international traffic, air transport has increased its freight handling by some 10 per cent from 1960 to 1961.

Perhaps what the coastal shippers, railways, roads and airlines must watch, apart from competition among themselves, is competition from a new transport concept—the hovercraft.

Landscape with Miss Crowe

How can the right adjustment be found between the new needs of commercial concentrations, with their dense conurbations, and the old landscape which alone can provide the peace, the relaxation and contentment that are the traditional characteristics of the countryside? Miss Sylvia Crowe set out to answer the question at the Royal Society of Arts last week.

Miss Crowe—a past-President of the Institute of Landscape Architects and a consultant to the Central Electricity Generating Board—was giving the inaugural "Reflection Riding" lecture to commemorate the work of some American landscape architects who,with skill and understanding, have generated a place of natural beauty for the enjoyment of thousands. She began by observing that landscape architecture was not the just designing of gardens, but something which concerns the whole relationship between men and the organic world, an art rooted in the science of biology. Even deeper, she defined the birth of a civilization as that moment when men first become conscious of their surroundings.

In attempting to find a solution to the modern conflict of growing conurbations and man's need for the innate beauty of the countryside, Miss Crowe defined three lines of approach. First, the acceptance of landscape zoning, such as the national parks and areas of outstanding landscape value—change in these areas was allowed only as fast as it could be absorbed. Second, the efforts made to improve the design of structures and their relationship with the old landscape. And, third, there were the hopeful beginnings of a counter attack on waste areas—slag heaps being afforested or cleared away, and gravel pits were filled or converted into lakes and stocked with fish. Pollution of the rivers was lessening, and "clean air" was already increasing the range of plant life that grew in London.

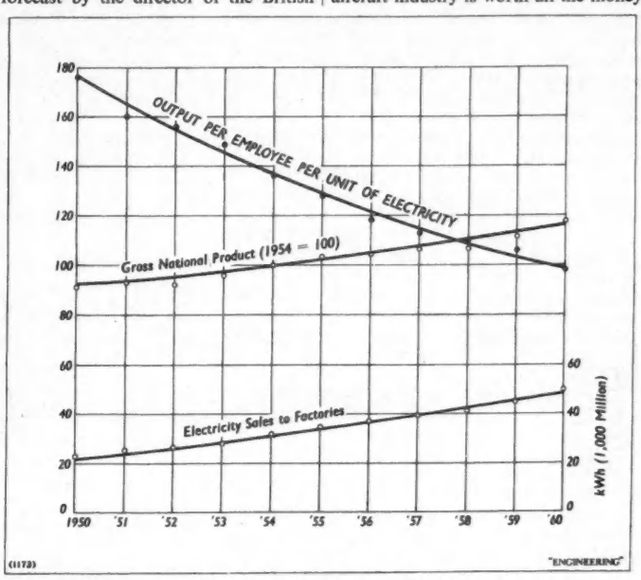
Yet there remained the failure to realize that the landscape was one interrelated, biological complex in which water conservation, flooding, afforestation, agriculture and all the works of man were linked and interacting. If landscape was to live, all its parts had to work together like the cells of an organism. This integration could only come with overall landscape planning.

The More Electricity, the More Output

The link between a nation's consumption of electricity and the total output of all its industries is so close that it is worth examining in the light of figures that were published last week in the *Annual Abstract of Statistics*.

On the graph, the two lower curves show (1) the sales of electricity to "factories and other industrial premises" in Great Britain, and (2) the gross domestic product of the United Kingdom (i.e. the total output by the nation of goods and services, without taking into account the net income from abroad). Both curves are for the eleven year period 1950-60.

Sales of electricity to factories follow the familiar pattern of electricity consumption in general: a doubling every ten years. The curve shows no sign of flattening—rather the reverse. The rate of increase of electricity consumption has surprised even the electricity authorities, and a recent forecast by the director of the British Electrical and Allied Industries Association suggests that "the rate of growth of demand will be greater in the next decade than in the last."



Industrial output and electricity consumption—the link between the two.

The curve of gross domestic product shows a rate of increase which is possibly improving slightly but is a long way off the figure of an annual increase of 4·6 per cent which has been put forward as a target for Western Europe and North America. Some of the existing Common Market countries have been achieving increases of this order in recent years, but as the curve shows, Britain has not—and neither has the United States.

The upper curve on the graph has been plotted to show the relationship between gross domestic product and electricity sales to factories. The figures for "total in civil employment" have been brought into the calculation, to produce a curve of gross domestic product per person employed per unit of electricity consumed in factories. (There is no point in defining the rather abstruse units of the vertical scale.)

Trends for the future?—possibly an improvement in the rate of increase of industrial output, greater application of electricity in industry, and a halt in the tendency, revealed by the upper curve, to make less productive use of industry's electricity. The biggest single factor will be the Government's degree of success with their proposed economic planning body.

The Profession's National Voice

While professional engineers discuss the desirability or otherwise of establishing a single, supreme body to speak for them nationally, the trade unions lobby Ministers on issues which are at least as vital to the profession as they are to the skilled and semi-skilled workers on the shop floor. Last week the Confederation of Shipbuilding and Engineering Unions sent a deputation of their leaders to call on Mr. Thorneycroft, Minister of Aviation, to impress on him the importance of building a supersonic airliner in Britain.

It has often been argued that the aircraft industry is worth all the money that is put into it by the Government, on the grounds that the industry pioneers important technical developments which are later of great value in other industries. Does it follow that it would be in the national interest for professional engineers—assuming their national body could reach unanimity of opinion—to urge expenditure on a project which otherwise the Government might decide to shelve? Neither the Government, the House of Commons, nor the Conservative Party has an adequate number of scientists and engineers, so some pressure from engineering interests may be overdue.

Others would argue, however, that representations at national level on matters of public interest should be left to non-professional bodies, such as the Federation of British Industries, which incorporates machinery for voicing engineering opinion.

Bogie Development on British Railways

A new bogie, the B4, is being adopted by British Railways. It weighs less than previous bogies, and has better riding qualities. All locomotive-hauled main-line passenger coaches built from 1963 onwards will be fitted with it.

THE riding qualities of railway vehicles have today become a very live and controversial subject. On British Railways, variation in the quality of ride differs from region to region and the public are always quick to compare—often unfairly—riding qualities abroad.

British Railways have however undertaken much painstaking and development work on bogie design in the last few years and in a paper recently presented to the Institution of Locomotive Engineers, Mr. E. S. Cox (assistant chief mechanical engineer to British Railways) undertook to survey the whole field of vehicle riding (excluding locomotives) and to place the apparent anomalies into some sort of relationship. This article briefly discusses some problems of bogie design mentioned in Mr. Cox's paper and dwells in rather more detail on the new B4 bogie.

Principles

A vehicle can oscillate along each of its three principal axes through the centre of gravity, and in addition it can also rotate about any of these axes. Most of the oscillations actually experienced are combinations of translatory and rotary displacements and various groupings of such combinations are coupled, so that one mode of oscillation may excite one or more of the others.

The excitation impulses originate at the rail. Vertical movements start from rail joints and variations in track levels. Laterally they depend upon the pattern of sinusoidal motion of the coned tyres on the rail, with displacements modified by variations in track gauge and by flange clearance. The mass of the vehicles and the elastic characteristics of all the components of both vehicles and track also have their effect.

Unknowns

The principal unknowns are:—

(1) The excitation sources from which the vehicle movements originate.
(2) The relation of energy input and dissipation, and the laws which apply.
(3) The inherent damping values of the different suspension components and their interplay, which have never been completely explored.
(4) The natural frequencies of track and roadbed cannot be as readily determined as those of the vehicle suspension members, and the inter-relation between each is obscure, although some studies have been made under idealized conditions.

Effects of Wear

Wear can promote bad riding by increasing designed clearances and by producing irregular shapes and defective surfaces on parts designed to work together in contact. Conversely, unsuitable suspension characteristics can, by promoting resonance and undue sensitivity to normal track irregularities, themselves accelerate the rate of wear of bogie components.

Thus introduction of physical means to reduce wear, such as alternative materials and larger bearing surfaces, and above all reductions in the number of wearing parts, cannot of itself cure bad riding unless attention is paid at the same time to the basic suspension design. The two things are interdependent to an extent which has not always been realized.

One pitfall, all too obvious at first sight, but frequently encountered, even on bogies having otherwise excellent suspension features, is the introduction of elements into the design which foul one another, and by contact between members which have become ridged in profile, introduce a rough and jerky movement into what should be smooth action. This is rather different from the problem of pure wear as such, and it could perhaps be described as design which invites wear.

BR Type B4 Bogie

By membership of the International Union of Railways (UIC), and its associated Office of Research (ORE), British Railways keep in close touch with European developments. With a view to possible application of design data made available from this source, the Swindon office of the Western Region was requested to prepare in collaboration with the then Railway Executive, a new bogie design which would tackle afresh the problem of good riding and develop the recommendations of the ORE report.

A pair of bogies were accordingly designed, built and put into service in 1956. The ensuing four years has subjected them to an exhaustive trial in which good riding has been maintained free from any marked deterioration. The duplicated frame channels on each side provide a simple rigid base on which primary and secondary coil springs and the swing links can be mounted in line, absence of offset promoting economy in material. The links can be of adequate length clear of the loading gauge, and there is plenty of room for knife edges, top and bottom, of generous dimensions. Recently they have been running in express services with tyres which have attained 140,000 miles since last turning. [This is considerably in excess of the average.] Riding has continued to be very good at that mileage, at which the tyres had only worn an average of $\frac{1}{16}$ in at the tread, yet again showing the inter-dependence of good riding characteristics and reduced tyre wear.

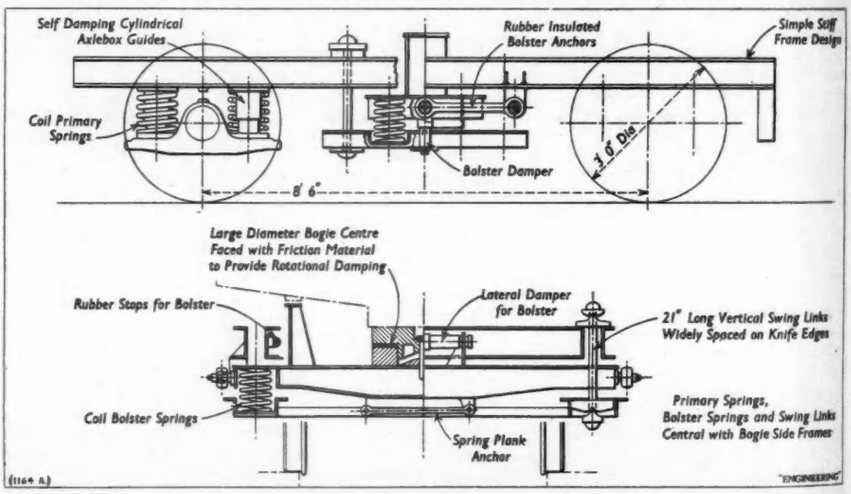
In the period in which these bogies were being exhaustively tried out, much consideration was being given to the general riding problem at Swindon in parallel with that being given elsewhere. Opportunity was taken following authority given in 1957, to build 50 further bogies of this kind, to improve the design in certain aspects so as to include all of the features likely to promote good riding. The resulting bogie is illustrated on this page.

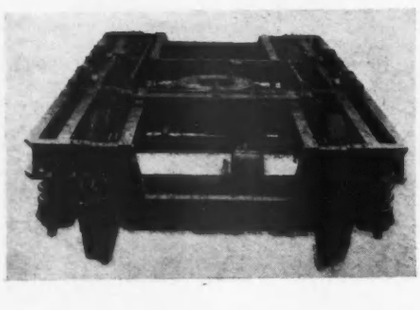
Modifications to the original design were :—

(1) Cylindrical axlebox guides, in place of normal type horn guides with manganese liners, in conjunction with pairs of coil springs joined by a bridge member over the axleboxes.
(2) Primary hydraulic damping integral with the centrally disposed guide columns, in place of eccentrically applied telescopic dampers.
(3) Upper and lower spring planks tied across to prevent lateral spring oscillation.
(4) Traction bar brought outside and disposed lower down.
(5) Traction bar connections free of lateral restraint.
(6) Use of 3 ft diameter wheels in place of the former 3 ft 7 in diameter standard.

Concluded opposite

Simplified drawing of the B4 bogie, developed at Swindon from European developments.


Self Damping Cylindrical Axlebox Guides
Rubber Insulated Bolster Anchors
Simple Stiff Frame Design
Coil Primary Springs
Bolster Damper
3' 0" Dia
8' 6"
Large Diameter Bogie Centre Faced with Friction Material to Provide Rotational Damping
Rubber Stops for Bolster
Lateral Damper for Bolster
21" Long Vertical Swing Links Widely Spaced on Knife Edges
Coil Bolster Springs
Spring Plank Anchor
Primary Springs, Bolster Springs and Swing Links Central with Bogie Side Frames
(1164 A.)
"ENGINEERING"



The B4 bogie has been running experimentally in express service and the tyres have attained 140,000 miles without the need for turning. Riding has continued to be good at that mileage.

Thermal Storage Valve

An advanced design of gas-tight sealing valve, known as the Metro-Flex, has been announced by the Metropolitan Engineering Company. The valve illustrated is for gas-ducts between 8 in and 14 in diameter; in other designs, ducts of up to 36 in diameter can be sealed. The valve will operate at high temperatures (over 600° F) withstanding gas pressures of up to 30 in wg. The gases—such as in boiler flues—can be dirty, dust-laden or corrosive without, it is claimed, adversely affecting the valve's operation.

With ducts of the sizes mentioned it is usually of major importance that the motion of the gases is unimpeded; thus the valve must impose no restriction at all when in the open position. The valve, therefore, is an integral part of a specially designed flue-way within which it operates.

When the ball of the valve is open the gases follow the streamlined surfaces presented, both of the ball and of the flue-way; when closed the ball seats against flexible metal components which deflect to follow its curve. Because the gas-tight seal is effected in this way, by the resilience of the flexible metal and not through any mechanical fit, all moving parts have plenty of play and tolerance—essential under hot and dirty working conditions.

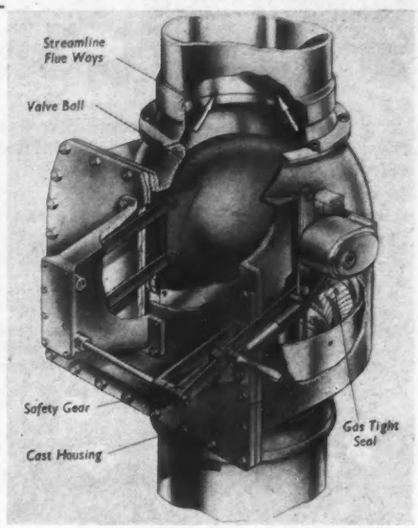
The valve is normally electrically operated, opening or closing upon the receipt of any signal at any predetermined rate. All moving parts, motor, ball and driving mechanism are easily removed externally, when the sealing components are revealed for examination.

The valve has a spring-assisted safety release. If pressure is exerted upon the underside of the ball when in the closed position, it will lift. As soon as the lifting motion begins, a spring will force the valve into the fully-open position, where it will remain until manually reset. It will then revert once more to fully-automatic operation.

When applied to chemical engineering projects the metal of the valve, flexible sealing components and flue-ways can be protected to withstand highly corrosive conditions. The wide clearances provided enable the valve to operate in a gas stream containing particles of solids and still maintain a gas-tight seal when required.

The valve is said to be ideal for boiler work. Whenever the burners cut-out the valve will close, isolating the boiler absolutely from the chimney pull and sealing in the heat. Even more important, cold air drawn through the flues is claimed to be entirely stopped, thus preventing one of the most common causes of smut emission and low-temperature corrosion. In effect, heating or hot-water boilers are used as thermal storage units whenever firing ceases.

The valve is automatically coupled in, to work in sequence with the burners which are electrically locked out of circuit until the valve is in the safe open position. Because the flues are kept much hotter during " off " periods an effective draught-flow is established immediately the valve opens, which represents a major advantage in terms of boiler safety and efficiency.



In boiler work, when the burners cut-out, the valve closes, isolates the boiler from the chimney pull, and seals in the heat.

The Metropolitan Engineering Company Limited, 47 Whitechapel High Street, London E1.

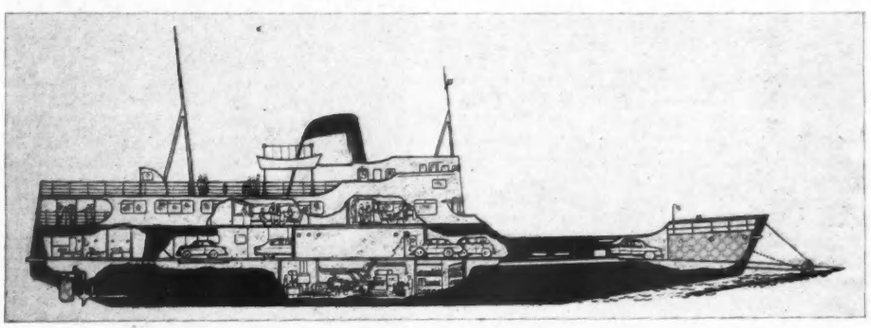
Ferry Can Handle Heavy Outsize Commercial Vehicles

The passenger/vehicle ferry Osborne Castle, launched recently from the Woolston Works of John I. Thornycroft, will, when she enters service in April of next year, considerably increase the available capacity for transport to the Isle of Wight.

This addition to the Red Funnel fleet has been developed from the Carisbrooke Castle. The experience with this vessel led the Red Funnel line to agree that the draught and the beam of the ship should be slightly increased and this allows more heavy commercial vehicles to be carried on the foredeck within the trimming limitations. Passenger saloons have been considerably enlarged and the after end of the promenade deck has been enclosed to provide more comfort in bad weather. In addition, the open top passenger deck has been extended in length.

Length overall of the Osborne Castle is 191 ft including the ram and fender, and the beam is 40 ft. Gross tonnage is 730 tons and the service speed is given as 14 knots. From tank tests with models, Thornycroft's anticipate that, while the ship's engines are similar to those installed in the sister ship and although the displacement is greater, the speed will be the same.

The twin screws are driven by two Crossley vertical 2-stroke direct reversing diesel engines. Each has eight cylinders and is continuously rated at 900 bhp at 450 rpm.



Not only passengers and cars, but heavy outsize vehicles can be carried on the ferry Osborne Castle.

Vehicle loading is effected by means of an articulated ramp placed at the extreme fore end of the ship. Side loading is also catered for; sliding doors in the vessel's side give access to the sheltered car deck, while hinged bulwark doors placed forward provide access to the larger vehicles. A turntable of 13 ft diameter is fitted flush into the after end of the car deck to assist in the stowage of vehicles.

If the ferry is used for passengers only, 1,200 can be carried. Normally, about 45 vehicles can be carried on the main deck, with unrestricted height at the fore end for lorries of up to 20 tons in weight each.

John I. Thornycroft and Company Limited, Thornycroft House, Smith Square, London SW1.

Concluding Bogie Development on British Railways

Four bogies were completed in the first place to the modified design and intensive experimental work was undertaken on choice of damping values and location of track bars. All six bogies, that is the original two and the later four, have subsequently gone into intensive service, and as mileage builds up, the desired pattern of continued good riding has been maintained. Trial running has taken place not only on the Western Region main line, but on the Eastern Region as well. On a recent run on the " Bristolian ", a representative of ENGINEERING noted the smoothness and quietness of the ride.

The problem of developing an alternative bogie relatively insensitive to normal track irregularities, capable of maintaining a good ride up to 150,000 miles, with minimum wear of tyres or components, at a cost and weight very much less than for certain other designs, has been achieved, not by substituting any other named or proprietary design, but by assembling a minimum number of simple components, providing few and ample wearing surfaces, and obeying those laws which are so far discernible amongst the whole system of mechanics as affecting vehicle and track. One other ingredient of the highest importance has also been assured, namely, a high degree of accuracy in jigging the frame and fitting up all its attachments.

This bogie represents in concrete form the stage in the solution of the riding problem previously referred to and it is intended to adopt it as a British Railways standard for main line coaches from 1963 onwards. [The bogies will be matched to suit different designs of coaches.] Its weight is 5 tons [a reduction of some 15 per cent compared with the BR standard bogie].

Enough has been said to indicate that railway vehicle riding is not a simple subject. Better understanding of the theory is desirable commercially. It would seem important to discover what the ceiling is liable to be, for no less than the future of railways as they are now known may possibly hang on the answer.

A Gas-Turbine for High Temperatures

A gas-turbine without blades has been designed to utilize the high temperature characteristics of ceramics and avoids the low ductility problem set by these materials.

By A. F. Elkouh, C. L. Sollenberger and D. McFarlin†*

Research Division, Allis-Chalmers Manufacturing Company

IT IS KNOWN from thermodynamics that a more efficient power cycle requires a higher maximum temperature. The drive toward a higher maximum cycle temperature has been slowed down by the unavailability of suitable high temperature materials. High temperature metallic alloys developed for aircraft gas turbine applications have an upper useful temperature limit in the neighbourhood of 1,650° F, above which they lose strength rapidly. The use of ceramics and ceramic-metal combinations as gas turbine components has resulted in little success because of lack of ductility.[1, 2]

An attempt to develop a ceramic to suit applications in a conventional gas turbine may take a long time. An approach to utilize the reasonably high temperature strength of ceramics and to overcome the low ductility problem in gas turbine applications is to adopt a non-conventional design. The non-conventional design considered is similar to that of Nicola Tesla.[3, 4] A stainless steel turbine was constructed and tested with compressed air at room temperature, to study the principles of operation and learn about factors affecting the turbine efficiency.

Turbine Description

The turbine rotor, Fig. 1, consists of eleven discs of 9·937 in outside diameter spaced about $\frac{1}{16}$ in apart. Each of the middle nine discs has a thickness of $\frac{1}{16}$ in while the outer two discs are $\frac{1}{8}$ in thick. High velocity gases enter the rotor at the outer periphery after expanding through the nozzle ring surrounding the rotor. The nozzle ring has eight convergent nozzles equally spaced around the rotor to allow for uniform rotor entrance conditions. The area of flow of each nozzle is $1\frac{5}{16}$ in by $\frac{5}{16}$ in and the flow direction makes 15° with the tangent to the rotor periphery. The total area of the nozzles is 2·56 sq. in. The rotor is mounted in a cast stainless steel casing, split along a plane normal to the turbine shaft. The total flow area of the nozzles is such that the flow conditions at the rotor inlet are subsonic. Fig. 2 shows the turbine with half the casing removed and Fig. 3 shows a cross sectional view of the turbine.

Principles of Operation

The high velocity gases from the nozzles form a strong vortex between the rotor discs. Each fluid particle describes a spiral path relative to the rotating discs while moving inwards towards the rotor exhaust ports. The fluid particles then move axially through the rotor exhaust ports to the exhaust chambers on each side of the casing and then to the atmosphere through ports in the exhaust chambers. Momentum is transferred from the high velocity vortex to the discs by viscous action in the boundary layer.

An overall momentum balance over a flat plate can be used to give a limiting value of the turbine maximum efficiency. Fig. 4 shows an extreme situation where the absolute velocity of the gas at the plate exit is equal to the plate velocity.

Experimental

The turbine is mounted on a heavy steel plate. A compressor of the type B—General Electric turbo-supercharger was used to load the turbine. Load conditions were changed by throttling the compressor discharge.

* Dr. Elkouh is now at the Department of Theoretical and Applied Mechanics, Marquette University, Milwaukee. † Mr. McFarlin is now with the Department of Mechanical Engineering, University of Delaware, Newark, Delaware.

Turbine Evaluation

The maximum turbine efficiency was found experimentally to be about 41 per cent. To reach a maximum cycle efficiency of 35 per cent, which may be taken as a reasonable value for a stationary power plant, a temperature ratio of about twelve is needed for a turbine efficiency of 46 per cent. In other words a temperature of about 6,000° F at the turbine inlet should be reached. Since most ceramics and cermets melt or lose strength below this temperature the material problem to suit this turbine design is yet to be solved. However, in applications where high temperature gases are available as in a rocket propulsion system and where efficiency is not of major importance as in generating power for auxiliary systems, this design may be used for a ceramic turbine working under a reasonably high temperature.

This turbine is a high-speed low-torque machine and does not have the characteristic of high torque at low speed which is desirable for traction application. The maximum power developed in these experiments is 10·1 hp at a speed of 6,300 rpm.

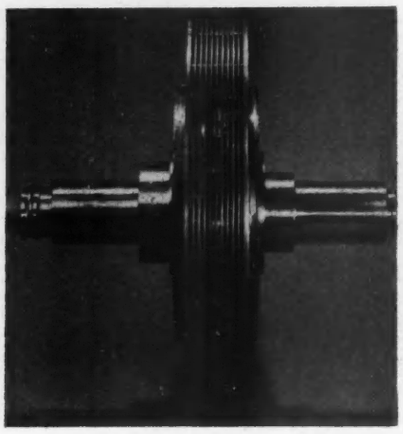


Fig. 1 (top left) The turbine rotor consists of eleven blades spaced about $\frac{1}{16}$ in apart.

Fig. 2 (top right) The turbine with half of the casing removed.

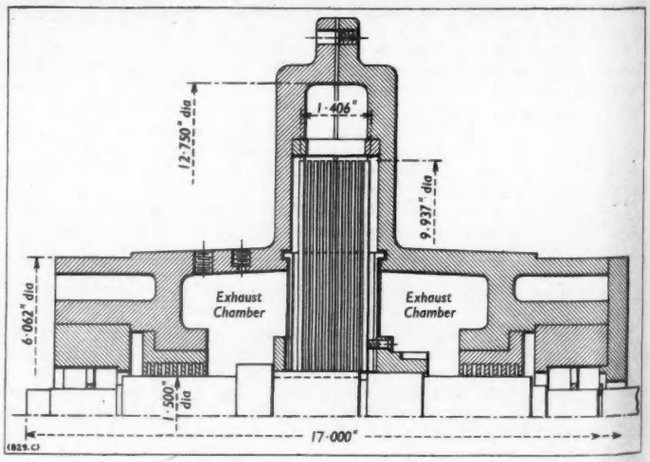


Fig. 3 (middle right) Cross-sectional view of the turbine.

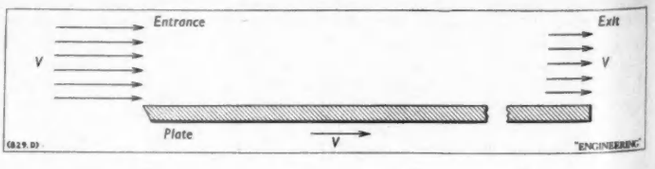


Fig. 4 (bottom right) An overall momentum balance over a flat plate can be used to give a limiting value of the turbine maximum efficiency.

References

[1] P. T. Chiarito and J. Johnston, "Experimental Evaluation of Cermet Turbine Stator Blades for Use at Elevated Gas Temperatures," *NASA Memo*, Feb. 1959.

[2] G. C. Deutsch, A. J. Meyer Jr., and G. M. Ault, "A Review of the Development of Cermets," *AGARD Report 185*, March-April, 1958.

[3] "The Tesla Steam Turbine," *Engineering News*, Vol. 66, pp. 448-449, 1911.

[4] "Theory of the Tesla Turbine," ENGINEERING, Vol. 99, p. 423, 1915.

[5] H. A. Sorensen, *Gas Turbines*, The Ronald Press Company, 1950.

Acknowledgments

The authors wish to acknowledge Mr. W. Mitchell, Jr., and Dr. C. Armitage for their contributions in starting this programme. Thanks are due to Mr. K. Neusen for part of the thermodynamic calculations and Mr. R. Baugh for his technical assistance. All are of Allis-Chalmers Manufacturing Company.

Copies of the full paper of which the above is a digest can be obtained free of charge from Allis-Chalmers Manufacturing Company, Research Division, Box 512, Milwaukee, Wisconsin, USA.

A Finance House Goes Motor Racing

Rising costs and the reluctance of the trade to support "also-rans" has forced owner-drivers out of Formula I racing. Private backers are now concerns of greater substance, including two finance houses. One will be racing as the Bowmaker-Yeoman team next season.

SINCE its inception, Grand Prix racing has relied on the powerful works teams to provide the main spectator attraction and almost invariably the winner. But no race seems complete without an assortment of private entries, often colourful personalities who evoke considerable interest with the possibility of a dark-horse producing a surprise.

In spite of his outstanding reputation and undisputed skill, Stirling Moss was privately entered at this year's Monaco Grand Prix. Overcoming a power deficiency of at least 30 bhp, he won one of the most thrilling races of the year when he brought an out-dated car over the line ahead of the full might of the Ferrari works contingent.

However with rising speeds and increased output per litre, the cost of competing in the larger events has risen correspondingly and the owner drivers and small garage concerns seldom justify the trade support which is so essential. Their place has been taken by larger undertakings who alone are in a position to enter teams of the latest cars, prepared by experienced mechanics and driven by world class drivers. Such is now essential to achieve anything more than to be merely a hindrance to the highly developed and organized works entries.

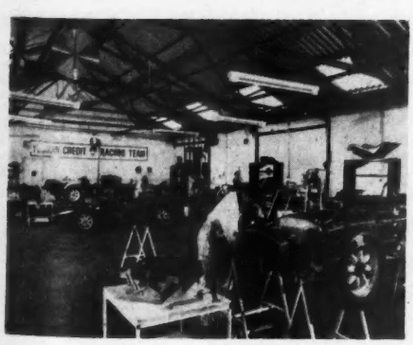
ORIGINS

One of the most prominent of these participants in recent years has been the Yeoman Credit racing team whose Yeoman blue and red cars, besides earning a reputation for impeccable preparation, have put up some notable performances during the past season.

So familiar have Yeoman Credit become on racing circuits, that the name has arisen out of comparative obscurity to become universally known among racing enthusiasts. Few people outside the world of finance knew much about the firm prior to the advent of the racing team and furthermore it is possible that those who follow its racing fortunes are unaware of the organization behind it.

Yeoman Credit Limited were founded in October, 1954, by Joseph Samengo-Turner, the son of an Italian bank owner. He had experience of finance on the Continent, but in 1940 came to England with his three sons and formed the firm of Joseph Samengo-Turner Limited. In 1947 the first link with cars was forged with the inception of a division to deal with hire purchase facilities for the motor trade. It was this division which remained predominant in 1954 when the name Yeoman Credit was introduced. The company then employed 10 people and had assets of £56,000.

By 1957 assets had risen to £1,000,000 and the firm was taken into the Bowmaker Group.



The racing team headquarters at Hounslow, Middlesex, where six mechanics work on the meticulously prepared cars which are now a familiar sight on the major racing circuits of the world.

John Surtees halts beside an Albion transporter to discuss a point after a test run made at Brands Hatch. Reg Parnell (left) and Fabian Samengo-Turner look on.

Joseph joined the Bowmaker board and his sons took over Yeoman Credit with William and Paul as joint managing directors and Fabian as deputy general manager. Paul is now director of Euro-Credit, Basle. By 1960 there were 450 employees, 230 in 30 branches and the rest at the newly built Yeoman House headquarters at Kew Bridge, Brentford.

All three sons shared a passion for motor sport and in September, 1959, it was decided to sponsor a racing venture. The team was initially managed by the British Racing Partnership under the auspices of Ken Gregory and Alfred Moss, the father of Stirling. 1960 was the first full season when the team was fully established in its own right, managed by Reg Parnell, one of Britain's most successful all-round drivers after the war and late team manager of Aston Martin.

On November 1, 1960, the team moved into its existing headquarters at Hounslow on the outskirts of London. The building occupies a floor space of 2,500 sq. ft and its pleasant working conditions, enhanced by good lighting and an even temperature maintained by an oil-fired fan heater, exemplify Mr. Parnell's philosophy that comfort is essential to ensure the exacting standards of workmanship required in the preparation of a racing car. Equipment is not lavish, but adequate for the work. Specialist repairs such as crash damage are contracted out, although minor straightening jobs are tackled on a hydraulic press. A large stock of spares is carried in a well-laid out storeroom and any component which is in any way suspect is immediately replaced.

The steady decrease in engine size over the last few years has necessitated a more scientific approach to racing car design. Speed no longer stems from size and brute force. Weight reduction is therefore crucial and as more power has been laboriously extracted from fewer cc, safety factors (often in engineering, factors of ignorance) have had to be examined very carefully. This, of course, directly affects the reliability of the car and increases the responsibility of the mechanics accordingly.

Six mechanics are employed at Yeoman Credit and they have had in their care this past season five Cooper cars fitted with the Coventry Climax 4-cylinder engine and an option of the Cooper or Colotti 5-speed gearbox. Two transporters are used—an Albion, which carries four cars and provides workshop facilities, and a Ford. During the summer 35 meetings were attended and the team covered most of the world including New Zealand, Syracuse, America, Scandinavia and all the major European races. Drivers throughout the season were John Surtees and Roy Salvadori and in terms of results, probably their greatest success was the Glover Trophy at Goodwood which Surtees won with Salvadori third.

Although the 1961 world championship events have been dominated by Ferrari, especially on the faster circuits, Surtees' drive in the Belgian Grand Prix at Spa was a most creditable effort in which he finished fifth behind four Ferraris. Surtees, a former world champion on two wheels, is a comparative newcomer to car racing whilst Salvadori, one of the most experienced of top-flight drivers, has been racing sports and Grand Prix cars for 15 years.

Three cars are at present in New Zealand and will probably be sold there as new cars have been ordered for next season. These will be Lolas, and both Surtees and Salvadori have signed on again to drive them under the new name of Bowmaker-Yeoman next season, despite a tempting offer from Ferrari for the former.

The switch means that the team will, in future, be actually a works entry as the four cars will be the only Lolas built for formula I, and will receive the full backing of the Lola works. The Lola story is one of success in itself as these cars, built by the Broadley brothers at a modest premises in Bromley, are the direct descendants of a special built for the 1172 formula in 1955 and still racing successfully in that class today.

MORE POWER

They will be fitted with Coventry Climax V8 engines and, whilst no one would be prepared to estimate the extra power that Ferrari will extract from his V6s during the winter, there is every possibility of the power gap being reduced or even closed. In addition there will be the BRM V8 and Porsche flat-8 engines so that, with the superior road holding of the British cars, next season should see some close racing in which the Bowmaker-Yeoman Lolas may well figure prominently.

What is the reason behind this endeavour? Why should a firm, whose professional interests would appear to have only marginal connections with motor racing, become involved in its participation? Undoubtedly it is expensive but as the reputation of the team increases, so does the starting money and trade support it can command.

Any deficit must surely be repaid by the publicity obtained and the value of having the name kept constantly in the public eye.

Another reason no doubt lies with the instigators of the project who, besides a personal interest, firmly advocate racing as a testing ground for modern automotive design. They believe that in addition to the prestige that success brings to this country, the cars and the manufacturers of the components included in their construction, Bowmaker-Yeoman is playing a worthwhile part in improving the breed of the cars of tomorrow.

Plain Words

By Capricorn

HAVE engineers paid sufficient attention to the design of Christmas presents? Except for a few engineers specially engaged in this kind of work, have engineers generally given it any thought at all? It's all very well building giant rolling mills, experimenting with hovercraft and messing about with electronics, but it's time some of the research and development effort for which engineering is famous was put into such seemingly mundane but potentially exciting things as Christmas presents.

Throughout the year the shops are full of things we want but cannot afford. There are deep-freezes, record-players, power tools for the home workshop, garden barbecues, and other devices which are considered more or less essential to the executive's home. Status symbols of the affluent society glisten in the shop windows, a constant irritant as we tread the familiar route to the office. Inside the department store, as we descend to the ironmongery basement to buy two dozen countersunk-head screws, the gleaming pastel porcelain of the " Mayfair " suite makes us almost ashamed to think of the Edwardian bath at home with its nickel plate worn through to the brass, and the marks of corrosion which even the most advertised cleaning powder fails to remove.

Yet when Christmas comes the only thing we can think of to give Uncle George is a tie which he probably won't like, and the only thing Uncle George can think of for us is a scarf—and we never wear scarves.

Of course the snag is that a professional engineer is only interested in real engineering. He can't bring himself to deal with the frivolous things of production. He is not happy—so he thinks—unless he is engineering something he believes to be worthy of his special talents. When his political masters tell the electorate that the standard of living is to be doubled in twenty-five years, it makes him kind o' proud as he dreams of bigger and better turbo-alternators, or he plans an automatic production line which will devour steel strip and be controlled by a computer. To ask him to give serious attention to something which will sell in the shops for 29*s* 11*d* is to insult him, yet that is what the consumer thinks of when he is wooed by the politicians' talk.

I must be fair to those few engineers who have already made this switch of allegiance. I have not forgotten, for instance, those engineered products with which Good Mornings begin. They shine like good deeds in a naughty, armament-crazy, prestige-seeking, international-jealousy world. But there are too few such innocent products which have been properly engineered. As I scour the shops for Christmas presents, I end up in the tie department. If I am buying for the friend who has everything—just everything—a tie is still a neat solution, because a tie can be handed on later for birthdays, until it reaches someone who likes the design.

Letters to the Editor

Speaking for the Professional Engineer

SIR, As a Canadian mechanical engineer (B.A.Sc. Toronto, 1934) and a member of the American Society of Mechanical Engineers now managing a small engineering firm in this country, I wish to express my complete agreement with your Impact notes " Professional Engineers " and " Specialist Institutions " (ENGNG., 17 Nov. '61, p. 633).

The word " engineer " has been debased by every little plumber, electrician and handyman, while the word " scientist " has been placed on an almost sacred pinnacle. But it still takes the basic engineers (civil, mechanical, electrical, chemical and mining) to provide the tools, machines and buildings to get the job done.

A similar problem has arisen in the United States, but there, the ASME and the other major founder societies in engineering have united in building the magnificent new engineering societies building (United Engineering Center) in New York City, to house their respective head offices.

The growth and scope of the ASME has been astonishing in recent years and has inhibited the growth of " specialist societies," but there are important ones, such as the American Society for Testing and Materials, the Society of Automotive Engineers and the American Welding Society, with whom ASME has close cooperation and often joint conferences.

A glance at the programmes for ASME conferences or at their magazine *Machine Design*, would be a revelation to many English engineers with mystical letter combinations proudly listed after their names.

Yours faithfully,
JAMES A. HARLEY,
Managing Director.

Steele and Cowlishaw Limited,
Stoke-on-Trent.
20 November, 1961.

Governor for Diesel Fuel Pump

SIR, We have transmitted to Mr. Bessière, author of the Society of Automotive Engineers' paper " New Single-Piston Injection Pump 'Silto' and Its 'Liquid Stop' Governor System," which you recently summarized (ENGNG., 1 Sept. '61, p. 262), the comments from your two correspondents, Mr. W. A. Green and Mr. N. T. Beesley (29 Sept. '61, p. 401, and 6 Oct. '61, p. 434).

We have now received from Mr. Bessière the undermentioned reply which he has asked us to pass on to you:

" I have read with interest the comments of Mr. Green and Mr. Beesley and I must congratulate them on their perspicacity.

The article published in your journal is, as a matter of fact, a summary of the paper I presented in Detroit.

In your article you published only the basic diagram, which I generally use for explaining to my readers the ' liquid stop ' principle.

Without going through all the relevant details, the diagram proves the ' self-regulating ' tendency of the device, i.e., that the fuel delivery is decreasing when the speed is increasing (owing, for example, to the load becoming less) or vice versa. But I did not say, talking about this diagram, that the delivery should decrease to such an extent that it keeps below a given value, the increase of speed. Your readers will also easily realize that there can be no delivery if the speed is approaching infinity.

In brief, the design as published in your journal does not explain more than the liquid stop principle, and does not deal with the full details of the governor, using this principle.

As a matter of fact, by using several artifices, I can obtain the full cut-off in the fuel delivery, and this, if I so wish, at a cost of only one per cent of the speed variation. The governor also permits speed variations (run-off) having the same value for all speeds of the engine; 5 per cent, for instance.

I can also obtain different run-off variations, such as:

5 per cent for 4,000 engine rpm
8 per cent for 2,000 engine rpm
12 per cent for 1,000 engine rpm
20 per cent for 500 engine rpm

I am using this device for passenger cars."

Yours faithfully,
C. HERLIN,
Service Direction.

Précision Mécanique Labinal,
Paris 8e,
25 October, 1961.

Designers with a Fresh Look

SIR, If I have read your Product Profile (ENGNG., 29 Sept. '61, p. 422) on Stothert and Pitt's most recent cranes rightly, you suggest a team of engineers who know nothing of cranes or the design of them make a better article than specialists.

Do you suggest this would hold good on such designs as Sydney Harbour bridge, a Rolls-Royce jet engine, Jaguar cars, or Herbert lathes?

Yours faithfully,
H. N. D'AETH.

The Lion Match Company Limited,
Durban,
Natal.
21 November, 1961.

Editor's Note.—It was certainly true in the case of the Stothert and Pitt DD2 dockside crane. The firm engaged a " team of graduate engineers, not specialists in crane design, to formulate an entirely new approach . . . " A similar policy might well pay off if it were applied to other products which seem to have stagnated. This is not, however, the only road to success in engineering: as the 56 Product Profiles published so far have shown, one or more of many different policies, each appropriate to the conditions, can determine the outcome.

Air Travel for Durgapur Steelworks Model

SIR, With reference to your short Companies article regarding the conveyance by air of a working model of a section of the rolling mill plant at Durgapur Steelworks (ENGNG., 17 Nov. '61, p. 649), may I be allowed to correct you on two points?

First, the overall length of the model was 31 ft, not 2 ft 8 in as stated. Secondly, while the estimated weight was 5 tons, as mentioned, this included packing cases. In actual fact, the finished weight was a little under 3 tons.

Packing cases were eventually dispensed with for convenience of handling and loading into the aeroplane.

The glass canopy was eventually made detachable and dispatched separately in two sections. The model itself was also in two sections. Four pantechnicons were used to transport this model from our works in York to London Airport.

The four separate sections were heavily wrapped in Cellophane and each section firmly attached to a " skid," or sledge-like structure, fitted with rope carrying handles. The glass panels were sent in a packing case separately.

The model was dispatched complete with spares, including motor, gear boxes, couplings, flexible drives, etc., and with a tool kit. The case was fitted with illumination in the top and plug points in the base for maintenance.

Yours faithfully,
H. CLARKSON.

H. Clarkson and Son,
York.
24 November, 1961.

Events in Advance

Events in 1962

With next week's issue of ENGINEERING a folder entitled "Events in 1962" will be issued as an inset. It will also include particulars of a number of events due to take place in 1963, of which some details are now available. The great majority of the events included in the folder have not so far been mentioned in the Events in Advance columns.

After publication, additional copies of the folder may be obtained free of charge on application to the Publisher, ENGINEERING, 36 Bedford Street, London WC2.

Meetings and Papers

The address and telephone number of the headquarters of each institution are given at the end of this list. Meetings in the headquarters town are held there unless otherwise stated.

Association of Supervising Electrical Engineers

LONDON
"Space Flight," by Dr. N. H. Langton. North London Branch. Wood Green Civic Centre, Wood Green, N22. Wed., 6 Dec., 8 p.m.

British Institution of Radio Engineers

LONDON
"Constant Luminance Colour Television": symposium of five papers. Television Group. London School of Hygiene and Tropical Medicine, Keppel Street, WC1. Thurs., 14 Dec., 6 p.m. (*Change of date*)
BIRMINGHAM
"The RRE Radio Telescope Interferometer," by H. Gent. West Midlands Section. Electrical Engineering Department, The University, Birmingham. Thurs., 14 Dec., 6.15 p.m.
EDINBURGH
"Jodrell Bank," by J. B. Wilson. Scottish Section. Department of Natural Philosophy, The University, Drummond Street, Edinburgh. Wed., 13 Dec., 7 p.m.
GLASGOW
"Jodrell Bank," by J. B. Wilson. Scottish Section. Institution of Engineers and Shipbuilders in Scotland, 39 Elmbank Crescent, Glasgow, C2. Thurs., 14 Dec., 7 p.m.
LIVERPOOL
"Nuclear Power Station Instrumentation," by M. W. Jervis. Merseyside Section. The Walker Art Gallery, Liverpool. Wed., 13 Dec., 7.30 p.m.

Building Centre

LONDON
"Coordinated Ranges for Buildings"; Discussion, to be opened by H. L. Gloag and W. E. Holley. Wed., 6 Dec., 6 p.m.

Combustion Engineering Association

DUNDEE
"Operational Boiler Defects and Methods of Repair"; Discussion, to be opened by F. Mosley, at 10 a.m. "The Problem of Grit and Dust Emission"; Discussion, to be introduced by H. Westwood, at 2 p.m. Royal Hotel, Union Street, Dundee. Wed., 13 Dec.

Diesel Engineers and Users Association

LONDON
"Annual Report on Oil and Gas Engine Working Costs and Performance"; Discussion, to be introduced by J. R. P. Smith. Institute of Marine Engineers, Mark Lane, EC3. Thurs., 14 Dec., 2.30 p.m.

Engineers' Guild

LONDON
Guild Luncheon. The Windsor Castle, Victoria, SW1. Mon., 11 Dec., 12.30 for 1 p.m.

Illuminating Engineering Society

LONDON
"Applying the Society's Code"; Discussion, to be introduced by Dr. H. H. Ballin. Federation of British Industries, Tothill Street, SW1. Tues., 12 Dec., 6 p.m.
LEEDS
"Problems of Heating Urban Motorways," by G. K. Lambert. Leeds Centre. City Art Gallery, The Headrow, Leeds. Mon., 11 Dec., 2 p.m.

Institute of Marine Engineers

LONDON
"Land Practice in Modern Steam Plant," by F. Dransfield and J. L. Gray. Tues., 12 Dec., 5.30 p.m.
BRISTOL
"Trials and Operation of the Gas Turbine Ship *Auris*," by R. M. Duggan and A. T. O. Howell. West of England Section. Samll Engineering Lecture Theatre, The University, University Walk, Bristol 8. Mon., 11 Dec., 7.30 p.m.

Institute of Metals

LONDON
"Feeding Non-Ferrous Metals Castings," by E. C. Mantle. London Local Section. Joint meeting with the London Branch of the Institute of British Foundrymen. National Liberal Club, Whitehall Place, SW1. Thurs., 14 Dec., 7 p.m.
GLASGOW
"Progress in the Electron Theory of Metals," by Dr. J. A. Catterall. Scottish Local Section. Institution of Engineers and Shipbuilders in Scotland, 39 Elmbank Crescent, Glasgow C2. Mon., 11 Dec., 6.30 p.m.

Institution of Civil Engineers

LONDON
"Maintenance of Hydro-Electric Schemes and the Development of Sidestream Intakes," by H. D. Morgan and D. D. Reid-Thomas. Tues., 12 Dec., 5.30 p.m.
"Traffic Design of Parking Garages"; informal discussion, to be introduced by L. T. C. Beasley. Traffic Engineering Group. Thurs., 14 Dec., 5.30 p.m.

Institution of Electrical Engineers

LONDON
"Diversity Reception and Automatic Phase Reception," by L. Lewin. Electronics and Communications Section. Tues., 12 Dec., 5.30 p.m.
"Electrical Aspects of Hunterston Nuclear Generating Station," by J. Henderson, G. F. Kennedy and Dr. K. J. Wootton. Supply Section. Meeting being held in conjunction with the British Nuclear Energy Conference. Wed., 13 Dec., 5.30 p.m
"Oscillating Machines: Synchronous and Asynchronous," by Dr. E. R. Laithwaite; "An Oscillating Synchronous Linear Machine," by Dr. E. R. Laithwaite and R. S. Mamak. Utilization Section. Thurs., 14 Dec., 5.30 p.m.
BELFAST
"Some Notes on the Electrical Requirements of General Cargo Docks," by E. R. Radway. Northern Ireland Centre. David Keir Building, Queen's University, Stranmillis Road, Belfast 9. Tues., 12 Dec., 6.30 p.m.
DUNDEE
"The Protection of Electrical Systems," by H. G. Bell. North of Scotland Subcentre. Electrical Engineering Department, Queen's College, Dundee. Thurs., 14 Dec., 7.30 p.m.
LEICESTER
"Some Notes on the Electrical Requirements of General Cargo Docks," by E. R. Radway. East Midland Centre. Joint Meeting with the Leicester Association of Engineers. Technical College, Leicester. Fri., 15 Dec., 7 p.m.
LIVERPOOL
"Education of an Electrical Engineer," by Professor M. R. Gavin; and "The Place of Formal Study in the Post-Graduate Training of an Electrical Engineer," by N. N. Hancock and P. L. Taylor. Mersey and North Wales Centre. Royal Institution, Liverpool. Mon., 18 Dec., 6.30 p.m.
MANCHESTER
"Americanism and Anti-Americanism," by Professor Marcus S. Cunliffe. North Western Centre. Engineers' Club, Manchester. Tues., 12 Dec., 7 p.m.
NEWCASTLE UPON TYNE
"Progress in Oil-Filled Cables and Their Accessories," by Dr. A. N. Arman, Dr. Ing. F. J. Miranda and G. B. Bishop; and "The Influence of Ageing on the Characteristics of Oil-Filled Cable Dielectric," by Dr. Ing. P. Gazzana-Priaroggia, Dr. Ing. G. L. Palandri and Dr. Chem. U. Pelagatti. North Eastern Centre. Neville Hall, Westgate Road, Newcastle upon Tyne. Mon., 11 Dec., 6.15 p.m.

Institution of Engineering Designers

NEWCASTLE UPON TYNE
"Oil Refining," with film, by A. H. Goodliffe. North East Branch. Rutherford College of Technology, Northumberland Road, Newcastle upon Tyne 1. Mon., 11 Dec., 7.15 p.m.

Institution of Engineers and Shipbuilders in Scotland

GLASGOW
"Diesel-Electric Propulsion Equipment in West Germany," by Dipl. Ing. H. Jung and F. Fass. Tues., 12 Dec., 6.30 p.m.

Institution of Heating and Ventilating Engineers

LONDON
"Fire Protection in Buildings," by E. A. Hibbitt. Institution of Mechanical Engineers, 1 Birdcage Walk, St. James's Park, SW1. Thurs., 14 Dec., 6 p.m.
BIRMINGHAM
"Fans: Types and Uses," by J. W. Stammers. Birmingham Branch Graduates' Evening. Engineering Centre, Stephenson Place, Birmingham. Tues., 12 Dec., 6.30 p.m.

Institution of Mechanical Engineers

LONDON
"Instrumentation Problems of Internal-Combustion Engine Development," by J. G. G. Hempson. Automobile Division. Tues., 12 Dec., 6 p.m.
"Problems of Commuter Traffic in Conurbations, by Anthony Bull. Thomas Hawksley Lecture. Wed., 13 Dec., 6 p.m.
BELFAST
"Design, Commissioning and Operation of Blyth "A" Power Station," by A. E. Powell and E. Forth. Northern Ireland Branch. Central Hall, College of Technology, Belfast. Tues., 12 Dec., 6.30 p.m.
BRISTOL
"Maintenance Experience of the Calder Reactor," by J. R. Treharne. Nuclear Energy Group: Western Branch Area. University Engineering Laboratory, Bristol. Thurs., 14 Dec., 7 p.m.
HUDDERSFIELD
"Gear Contact Phenomena," by Dr. H. E. Merritt. Yorkshire Branch. College of Technology, Huddersfield. Wed., 13 Dec., 7 p.m.

Institution of Nuclear Engineers

LONDON
"Nuclear Propulsion of Ships," by Captain H. Atkins. Annual General Meeting. Caxton Hall, off Victoria Street, SW1. Fri., 8 Dec., 2.30 p.m.

Institution of Production Engineers

LEEDS
"Grinding and Precision Machining Techniques," by H. F. Plant. Leeds Section. Hotel Metropole, King Street, Leeds 1. Mon., 11 Dec., 7 p.m.
LINCOLN
"The Production Engineer: Today and Tomorrow," by F. W. Cooper. Lincoln Technical College, Lincoln. Wed., 13 Dec., 7.30 p.m.

Institution of Public Health Engineers

LONDON
"Fresh Water from Sea Water," by William K. J. Weir. Caxton Hall, off Victoria Street, SW1. Thurs., 14 Dec., 6 p.m.

Institution of Structural Engineers

LONDON
"Chemical and Physical Effects of Aggressive Substances on Concrete," by Dr. P. E. Halstead. Thurs., 14 Dec., 6 p.m.

Junior Institution of Engineers

LONDON
"History and Work of the Railway Inspectorate of the Ministry of Transport," Presidential Address, by Brigadier C. A. Langley. Fri., 15 Dec., 7.30 p.m.

Liverpool Engineering Society

LIVERPOOL
"HMS Liverpool," by R. B. Summerfield. Wed., 13 Dec., 6 p.m.

North East Coast Institution of Engineers and Shipbuilders

NEWCASTLE UPON TYNE
"Investigations into the Strength of the Underdeck Girders Carried out at Glengarnock," by K. V. Taylor and J. S. Shand. Mining Institute, Neville Hall, Westgate Road, Newcastle upon Tyne. Fri., 15 Dec., 6.15 p.m.

Presentation of Technical Information Group

LONDON
"The Formation and Presentation of Technical Terms," by C. W. Paul-Jones. New Engineering Block, University College, Malet Street, WC1. Tues., 12 Dec., 6.15 p.m.

Radar and Electronics Association

LONDON
"Loudspeaker Enclosures," by J. Gough and Professor F. Landgrebe. Royal Society of Arts, John Adam Street, Adelphi, WC2. Thurs., 14 Dec., 7 p.m.

Reinforced Concrete Association

BIRMINGHAM
"Recent Developments in Prestressed Concrete," by B. Rhodes. Midland Counties Branch. Birmingham and Midland Institute, Paradise Street, Birmingham. Tues., 12 Dec., 6 p.m.

Royal Society of Arts

LONDON
"The Duke of Edinburgh's Award Scheme," by Sir John Hunt. Wed., 6 Dec., 2.30 p.m.

Royal United Service Institution

LONDON
"Some Reflections on the Strategic Air Offensive, 1939–1945," by Dr. Noble Frankland. Wed., 13 Dec., 3 p.m.

Sheffield Metallurgical Association

SHEFFIELD
Film Evening. BISRA Laboratories, Hoyle Street, Sheffield. Tues., 12 Dec., 7 p.m.

Society of Instrument Technology

LONDON
"Application of Complex Plane Methods to System Design," by P. K. M'Pherson. Control Section. Manson House, 26 Portland Place, W1. Wed., 13 Dec., 7 p.m.
BRISTOL
"Atomic Clock," by Dr. L. Essen. Bristol Section. Department of Physics, The University, The Royal Fort, Bristol 8. Thurs., 14 Dec., 7.30 p.m.
CHELTENHAM
Film Evening. Cheltenham Section. Belle Vue Hotel, Cheltenham. Wed., 13 Dec. 7.30 p.m.

South Wales Institute of Engineers

CARDIFF
"Modern Process Control," by O. G. Pamely-Evans. Thurs., 14 Dec., 6 p.m.

West of Scotland Iron and Steel Institute

GLASGOW
"Operating Experience with an 80 ton Electric-Arc Melting Furnace," by J. M. Mowat, A. G. McMillan and R. McDonald. Thurs., 14 Dec., 6.45 p.m.

Association of Supervising Electrical Engineers, 23 Bloomsbury Square, London WC1. (LANgham 5927)
British Institution of Radio Engineers, 9 Bedford Square, London WC1. (MUSeum 1901)
Building Centre, 26 Store Street, London WC1. (MUSeum 5400)
Combustion Engineering Association, 70 Jermyn Street, St. James's, London SW1. (WHItehall 5536)
Diesel Engineers and Users Association, 18 London Street, London EC3. (ROYal 2393)
Engineers' Guild, 201 High Holborn, London WC1. (HOLborn 1057)
Illuminating Engineering Society, 32 Victoria Street, London SW1. (ABBey 5215)
Institute of Marine Engineers, Memorial Building, 76 Mark Lane, London EC3. (ROYal 8493)
Institute of Metals, 17 Belgrave Square, London SW1. (BELgravia 3291)
Institution of Civil Engineers, Great George Street, London SW1. (WHItehall 4577)
Institution of Electrical Engineers, Savoy Place, Victoria Embankment, London WC2. (COVent Garden 1871)
Institution of Engineering Designers, 38 Portland Place, London W1. (LANgham 8847)
Institution of Engineers and Shipbuilders in Scotland, 39 Elmbank Crescent, Glasgow C2. (Central 5181)
Institution of Heating and Ventilating Engineers, 49 Cadogan Square, London SW1. (SLOane 3158)
Institution of Mechanical Engineers, 1 Birdcage Walk, St. James's Park, London SW1. (WHItehall 7476)
Institution of Nuclear Engineers, 147 Victoria Street, London SW1. (VICtoria 6423)
Institution of Production Engineers, 10 Chesterfield Street, London W1. (GROsvenor 5254)
Institution of Public Health Engineers, 179–181 Vauxhall Bridge Road, London SW1. (VICtoria 3017)
Institution of Structural Engineers, 11 Upper Belgrave Street, London SW1. (SLOane 7128)
Junior Institution of Engineers, Pepys House, 14 Rochester Row, London SW1. (VICtoria 0786)
Liverpool Engineering Society, 9 The Temple, 24 Dale Street, Liverpool 2. (Central 3717)
North East Coast Institution of Engineers and Shipbuilders, Bolbec Hall, Newcastle upon Tyne 1. (Newcastle 20289)
Presentation of Technical Information Group. Apply to Mr. B. C. Brookes, University College London, Gower Street, WC1.
Radar and Electronics Association, 45–47 Mount Street, London W1. (GROsvenor 4477)
Reinforced Concrete Association, 94–98 Petty France, London SW1. (ABBey 4504)
Royal Society of Arts, John Adam Street, Adelphi, London WC2. (TRAfalgar 2366)
Royal United Service Institution, Whitehall, London, SW1. (WHItehall 5854)
Sheffield Metallurgical Association, 64 Crescent Road, Sheffield 7. (Sheffield 52865)
Society of Instrument Technology, 20 Queen Anne Street, London W1. (LANgham 4251)
South Wales Institute of Engineers, Park Place, Cardiff. (Cardiff 23296)
West of Scotland Iron and Steel Institute, 39 Elmbank Crescent, Glasgow C2. (Central 5181)

Human Element

Increasing Significance of the Diploma in Technology

THE latest Diploma in Technology pass list, issued last week by the National Council for Technological Awards, reaches two milestones. One is the awarding for the first time of Dip Techs in applied biology and in chemical engineering, and the other is the inclusion in the pass list for the first time of students from the Bristol College of Technology, the Huddersfield College of Technology, and Northern Polytechnic. The wider the influence of the Dip Tech, both in its subject matter and geographically, the sooner will holders of the qualification, with their blend of industrial know-how and academic prowess, prove their real value to industry, and the less will it be necessary to find yardsticks for the Diploma in Technology by equating it with university honours degrees.

It was in November, 1956, that the Council began to recognize courses as suitable for leading to the award of the Dip Tech, and the number of students now studying for the diploma is over 5,000. Including the students appearing in this latest pass list, Dip Techs have now been awarded to 675 men and 10 women.

Since the end of 1959, the Council has also offered a higher award, Membership of the College of Technologists (MCT), which is broadly equivalent, the Council consider, to a British Ph.D. Already, 35 applicants have been registered for MCTs, and three further applications are now under consideration by the College of Technologists.

A Commercial Traveller's Dream

A new Shell film, "The History of the Oil Engine," relates how, in 1861, a commercial traveller dreamed of building a new kind of engine. He fulfilled that dream with the creation of an atmosphere engine, the forerunner of the first 4-stroke internal combusion engine, and he made it in 1876. His name was Nikolaus August Otto. The film traces the story of Otto and Deutz, Herbert Ackroyd Stuart, the brothers Priestman, James Robson, and how they all played their part in the development of the compression ignition engine.

Rudolph Diesel made his first engine in the works at Augsburg, and the film shows the famous first explosion when it started up. He thereby proved that heavy oil could be ignited by compression alone and when the engine was blown to pieces, he is reported to have said "That's what I wanted to know."

After Diesel came James McKecknie with his development of a fuel pump, which was the beginning of pump injection as it is known today. Then, in the early 20th century, came the researches of Sir Harry Ricardo, who paved the way for modern high efficiency fuels and lubrication oils. Running parallel to this development of the engine, are shots of the development of the oil industry, from Col. Drake's well in Pennsylvania to laboratory technologists of the present day.

The film is unusual in that it is made entirely, except for the last two minutes, from still photographs, drawings, pictures and diaries. Yet in spite of this the film moves the whole time. Some 600 drawings, paintings, plans, photographs and books were gathered together and from them were chosen the 400 pictures around which the film was made. The illustrations range from a copy of the original sketch by Christiaan Huygens, of his gunpowder engine in the 17th century, to present day photographs of the Shell Research Centre at Thornton near Chester. Most of the material has never been shown on the screen before; some of it has been lying unknown in archives. The film runs for just over half an hour and is one of the many available on loan from Shell-Mex. Apart from a very short colour sequence at the end the whole film is in black and white.

Shell-Mex have also produced a booklet *An Outline History of the Oil Engine and its Lubrication* which covers the subject of the film and also elaborates it. The booklet, free of charge, and the film can be obtained from the Publicity Department, Shell-Mex House, Strand, London WC2.

The Most Elementary Form of Communication

In this age of perforated tapes, punched cards, inter-office memos and supersophisticated visual aids, the most elementary form of communication—the spoken word—remains as vital and as important as ever. Indeed, a large proportion of the industrial unrest which crops up from time to time has its origins in misunderstanding arising from a failure of communication by the spoken word.

The point at which communication can most easily fail in this way is at the foreman level. Very often, indeed, the foreman's interpretation and communication of the intentions of the higher strata of management to the man on the shop floor (and his ability to feed back to management shop floor reactions) is the whole key to management/labour relations within a firm or, even, within a whole industry. It is for this reason that the Institute of Industrial Supervisors have been holding a course, "Effective Speaking in Communication", over the past two months.

The course has been held on ten consecutive Saturday mornings in the Institute's new offices in Albert Street, Birmingham. Each lecture lasts one and a half hours and the series began early in October and will end on 9 December. Included in the syllabus are talks on the need for effective communication and how it is attained, the putting over of individual personality, and the art of speaking clearly with good delivery, pitch and tone. Later talks have dealt with phrasing, pace, emphasis, stress, the value of the pause, and clear thinking. Miss Gwen Muspratt has been in charge of the course, and she has given individual attention to each course member.

Lectures on public speaking and effective speaking are now included in a number of management courses, and several technical colleges run short courses of eight or ten sessions on the subject.

An organization which has paid particular attention to stimulating expertize in the spoken word is the Electrical Development Association, which holds an annual public speaking competition open to employees of the electricity supply industry under 35 years of age. In the 1962 competition the choice of subjects will be *Advertising with a Purpose*, *The Salesman as the Consumer's Friend*, and *Where Would You Put the Pylons*? These would seem to be unusually inviting subjects.

The competition will be held on a regional basis, with the winners of the area board competitions receiving useful area prizes and passing through to the national finals to be held in London during May. At present the holders of the Faraday Silver Challenge Shields—leading awards in the competition—are the East Midlands Board (women) and the Southern Board (men). A full description of the competition is available in a booklet called, appropriately, *Public Speaking is Great Fun*, issued by the Electrical Development Association, 2 Savoy Hill, London WC2.

National College for Heating and Ventilating

The National College for Heating, Ventilating, Refrigeration and Fan Engineering had its origins in courses held in the Borough Polytechnic during the war. When the Percy Report introduced the idea of national colleges for those industries which, while requiring advanced technological training, are so scattered that a single national centre is the only solution, the college was set up, in 1948, with the Minister of Education's approval. For some time the college made use of an old "three-decker" school, taken over from the Borough Polytechnic, until, in 1950, the Ministry agreed to the erection of a laboratory, restricted in size, but all that could be built on the old school yard.

Once again the college has had to expand, with the backing of the Ministry and industry, the latter donating more than £65,000. The Lecture Hall has been generously given by G. N. Haden and Sons, as a memorial to their former chairman, Mr. Nelson Haden. Mr. Haden was one of the chief promoters of the National College, and represented the Institution of Mechanical Engineers on the governing body.

At present there are 170 full-time students, but it is hoped that this number will be doubled before long, though a difficulty is that the present hostel can only accommodate 44 students. This is particularly unfortunate since the students are drawn from all over the country and a larger hall of residence would supply the corporate life which is lacking when people are dispersed in digs.

Foreign Competition

Sir David Eccles, the Minister of Education, in opening the new building, said that the National College and the Borough Polytechnic, working side by side, and in such close cooperation, presented an interesting contrast in methods of support. Whereas the National College was supported directly from the Ministry and from industry, the Polytechnic came under the Local Authority. Sir David made the point that he was hampered at all times by a shortage of capable trained research workers and he sincerely hoped that this shortage would be remembered in recruiting students to the college. The industry, according to his records, had an annual turnover of about £75,000 from 500 firms employing approximately 20,000 people. Were they really doing enough about education in view of the size of the industry? Both contractors and manufacturers should send students. Too much at the moment was being made to foreign designs and British designs were urgently needed, especially in view of the considerable competition that would shortly be experienced.

The Spectre of Redundancy

Fear of redundancy, as every work study engineer knows, is one of the principle obstacles to the acceptance of better methods. It is, however, a fear which can usually be allayed by forward-thinking management through the introduction of fair and clearly understood redundancy policies such as some of those described in the Ministry of Labour's booklet, *Security and Change—Progress in Provision for Redundancy*, published a few months ago.

Now, the problem has been tackled by a new British Productivity Council film, *Change and Employment*, made in conjunction with the European Productivity Agency. The film shows some of the technological changes in recent years and how they have affected the lives of operatives, and a contrast is made between the impact of change in present industrial conditions and during the period of mass unemployment before the war. Examples of good management practice are demonstrated where new processes and methods have altered the labour content of a job, and special attention is paid to the importance of avoiding hardship to employees.

Other recent BPC films are *A Case for Shiftwork*, which emphasizes the need for full and early consultation before the introduction of shiftwork; *The Man in the Middle*, dealing with a foreman's difficulties in relation to the work study officer, the maintenance engineer, the quality control engineer and other specialists; and *Fitting the Job to the Worker*, an introduction to ergonomics (ENGNG., 1 Sept., p. 280). Copies of BPC films can be hired from the Central Film Library, Government Building, Bromyard Avenue, Acton, London W3, or bought from the BPC, Vintry House, Queen Street-place, London EC4.

Institution of Works Managers Elections

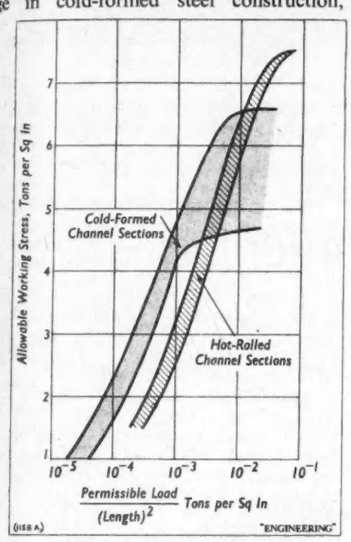
A month ago the Institution of Works Managers elected their new council and, subsequently, this council re-elected Lord Piercy as their president for the ninth year in succession. The new chairman is Mr. John Ayres, managing director of Simms Motor Units, and Mr. Cyril Starkey, technical director of Rozalex, becomes deputy chairman. Continuing in office as honorary treasurer is Mr. H. E. Drew, director of electronic production with the Ministry of Aviation, and Mr. R. S. Silman, managing director of Ship Carbon Company of Great Britain, has been re-elected membership counsellor. This is the thirty-first year of the Institution's activities.

Economics of Cold-Formed Steel Sections

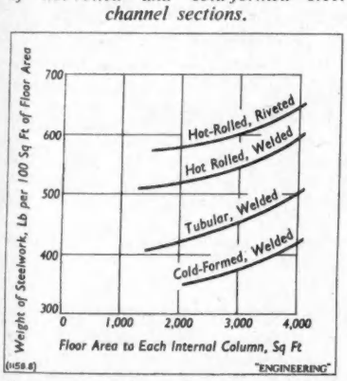
The basic strength problems of cold-formed steel sections originate in the thinness of the material. Thinness may give rise to twisting of tensile members, to local buckling where compressive stresses are high and to torsional buckling effects in columns and beams. "Structural Problems in the Use of Cold-Formed Steel Sections," was the title of a paper given by Professor A. H. Chilver, of University College, London, at the Institution of Civil Engineers, 14 November, discussing these points.

The relative thinness of cold-formed steel sections introduces a number of connection problems. Spot-welded connections must be designed so that local buckling does not occur between the spot-welds. At a bolted joint, local buckling may occur on the compressed side of the joint, and washers may have to be used.

High strength steel bolts may be used to advantage in cold-formed steel construction, the material requirements of the bolts being the same as in hot-rolled construction. Though the thinness of the members may imply that heavy concentrated loads cannot be transmitted through a bolt hole, the use of spacing washers between the members assists in eliminating local distortion around the hole.


Allowable Working Stress, Tons per Sq In
Cold-Formed Channel Sections
Hot-Rolled Channel Sections
Permissible Load / (Length)² Tons per Sq In
"ENGINEERING"

Comparison of the structural efficiency of hot-rolled and cold-formed steel channel sections.


Weight of Steelwork, Lb per 100 Sq Ft of Floor Area
Hot-Rolled, Riveted
Hot Rolled, Welded
Tubular, Welded
Cold-Formed, Welded
Floor Area to Each Internal Column, Sq Ft
"ENGINEERING"

Comparison of weights of steelwork used in industrial sheds for different methods of construction. The steelwork includes both roof and columns.

The versatility in the shape of cold-formed sections leads to considerable structural economy of material.

Under certain conditions it has been found that the allowable stress in cold-formed steel struts may be nearly double that in conventional hot-rolled steel struts, in spite of the cold form having a slightly lower yield stress than the standard material of the hot-rolled sections; this higher working stress means that less material is required in members. The graph also shows the cold-formed steel sections are more efficient than hot-rolled sections either when the permissible compressive load (P) is small or when the length of the column (L) is large.

An interesting comparison is shown in the weights of steelwork used in industrial sheds for different methods of construction, and from the second graph it would seem that cold-formed steel design is more economical than other rms of construction.

Professor Chilver said that "Structural design in thin-walled steel sections is still in its infancy in the United Kingdom. As the field develops, more refined techniques will be introduced. For example, there are indications at the present time that thin steel purlins can be used efficiently and economically in conjunction with hot-rolled steel work, though the design of such members is difficult since there is an important interaction between the purlins and the supported roof." This and similar problems will require careful research."

More Lightweight Concrete from Fuel Ash

The rapid expansion in the number of factories producing Thermalite may be taken as a guide to the popularity of the material in the building trade. In addition to the existing factories at Birmingham and Reading, new factories have recently started production at Grays (Essex) and Blyth (Northumberland), and last month another was opened by Professor Sir William Holford, president of the Royal Institute of British Architects, at Manchester adjoining the Agecroft Power Station.

Thermalite Ytong Limited are a member of the Laing Group of Companies and are Britain's largest producer of steam-cured aerated concrete. In the new factory it will be possible to maintain a production cycle of 22 hours with automatic mixing of the materials, through the various heating and steam-curing processes to the completion of the finished blocks. A new mix can be produced every 4½ minutes.

Pulverized fuel ash is the basic ingredient of Thermalite; hence the location of the new factory close to a coal fired power station. In addition to the ash, Portland cement and sand are the other main materials used. The finished product consists of a large number of independent air cells contained within walls of strong and durable mineral composition. It is less than half the weight of brickwork and only 60 per cent of the weight of clinker concrete. It also has good thermal insulation properties.

The wall units are mass produced in 18 in widths from 4 to 9½ in thick and in standard lengths up to 20 ft. The partition units are 18 in or 20 in wide and 3 in and 4 in thick in standard lengths up to 10 ft.

Thermalite Ytong Limited, Hams Hall, Sutton Coldfield, Warwickshire.

Building Scheme Completed Early

To mark the completion of the last of the eight storey flats built in the £403,458 Orlando Street redevelopment scheme at Walsall, Staffordshire, an opening ceremony was held early last month. The Orlando Street scheme is the largest single redevelopment scheme undertaken so far by the town council. It consists of four blocks of eight-storey flats, eleven two-storey terraced houses, a three-storey block of flats, and two blocks of three-storey terraced houses. The contract started on August 1, 1960, was scheduled to be completed by June 30, 1962, but this has been brought forward seven months.

The 40 acre area was originally covered by two and three-storey slum terraced properties, and the scheme has been designed to provide a mixed residential scheme for a total of 169 dwellings. Included in the development are 39 garages and 158 external stores.

The blocks of flats are built of reinforced concrete construction, with plate floors and multi-coloured brick facings. Each flat has a precast concrete balcony unit. Inside the flats, the floors are finished with thermoplastic tiles and the walls and ceilings have a plaster finish. A heating system using "Thermduct" is incorporated. The ducts are formed with an extractable inflated rubber tube laid in the floor screed.

The two and three-storey houses are of traditional brick cross-wall construction, with brick facings and built-up Stramit roofs.

The main contractors are the Midland division of Wates Limited, and the project was designed by the company working in conjunction with the Walsall Public Works Department.

Dexion Used in Grandstand Construction

The number of structures being built abroad using Dexion demonstrated the appeal of the material for its ease of construction.

In Rangoon over 120,000 ft of Dexion slotted angle are being used for six and ten tier grandstands seating over 6,000 spectators for the South East Asian Games. For the Independence Celebrations at the end of December at Dar-es-Salaam, Tanganyika, Dexion is being used for two 120 ft grandstands holding 2,600 spectators, two camera stands and a 125 ft high camera tower, and 2 miles of crush barriers.

In Italy, a Dexion framed building has recently been completed in 100 working days for a silk manufacturing company in Brescia. 14,000 ft of slotted angle were used in a steel framework 110 ft long, 65 ft wide and 13 ft high. Reinforced glass sheeting was used for the roof cladding, in addition to a false ceiling fitted to the underside of the roof trusses. The walls were completed with brick.

Dexion Limited, Overseas Division, Wembley, Middlesex.

New Seal Creeps Horizontally

Exploiting capillary attraction, a new sealer has been developed that will move horizontally as well as downwards. The SBD sealer No. 3 has been developed by Stuart B. Dickens Limited; it has a low viscosity and is suitable for cracks up to about ½ in wide. As it dries the sealer sets into a resilient, rubbery material adhering to the sides of the crack. It is not affected by water or acids, and since it does not become brittle it will accommodate small movements. The bond strength varies between 20 to 30 lb per sq. in. It has been used satisfactorily for gas proofing fine cracks in concrete, repairing hollow granolithic floor tappings, and it is being considered for sealing the cracks in sea walls to prevent damage from salt water.

Stuart B. Dickens Limited, Manor Way, Borehamwood, Hertfordshire.

Safety Booklet for Site Supervisors

To strengthen their safety campaign, the Federation of Civil Engineering Contractors have published a *Supervisors Safety Booklet* which is intended for everyone in the industry. It is based on an analysis of some 5,500 accidents over a two year period. Out of every 50 men in the civil engineering industry, during their working lives, on average, each will receive two "reportable" accidents, causing at least three days incapacity for normal work, and one of the fifty will be killed.

The booklet lays down the basic principles for preventing all the major causes of civil engineering accidents. It is available in pocket size and costs 5*s* post free from:

The Federation of Civil Engineering Contractors, Romney House, Tufton Street, London SW1.

Economic Quarrying for a Road

Large "down-the-hole" drilling rigs, carrying 6½ in drill bits, have been used successfully in highway construction through mountainous country by the Western American contractors, Isbell Construction Company of Reno, Nevada. Such heavy equipment is more commonly associated with open-cast mining and quarrying than construction work, but the contractor, faced with excavating 1,900,000 cu. yd of hard rock while building a 7½ mile length of highway, found the equipment economical to use.

The existing road had to be moved well back on the hillside to avoid the Kaweah River storage area that will be created by the completion of the Terminus dam next April. Cuts of as much as 150 ft on the face side, with 60 ft benches and fills up to 130 ft deep, indicate the magnitude of the job. Such was the nature of the strata that the specification called for totally dry fills and compactions of between 94 and 96 per cent were obtained without difficulty.

Drillmasters were used with the large drill bits. Down-the-hole rigs get their name from the fact that the actual drilling power, the impact stroke, is delivered directly on to the head of the bit; a 30 ft long rod, 4 in square, connects with the hammer and the bit rotates at 50 rpm. The action of the bit, including a rotation, is similar to that employed on ordinary size rock drills.

Using the 6½ in carbide insert bits, drilling rates ranged from 35 ft per hour in medium soft material to as little as 20 ft an hour in hard rock. Daily production per Drillmaster varied between 150 ft and 275 ft of hole. This was only half what was obtained by adjacent air tracks using 3 in bits but the advantage was gained by the much larger drilling pattern worked with the heavier equipment. With the down-the-hole rig, holes were put down on a grid with 10 ft by 12 ft centres—thus effectively drilling out an area of 120 sq. ft—whereas the smaller machine could only tackle a grid of 6 ft by 7 ft—or 42 sq. ft—so that the heavier equipment covered three times the ground. Standard procedure with the heavier cut was 20 ft lifts, three-day drilling cycles, and breaking up 5,000 to 6,000 cu. yd of rock as each round fired.

Although much more expensive—£153 for the 6½ in bit against £17 for the smaller 3 in bit—the life of the bigger one was much more. Isbell report an average of "well over 2,000 ft of hole" on the 6½ in bits, with an average re-sharpening life of 30 times. Experience showed that the big rigs required considerably less maintenance than the air tracks, but in mobility the two types were about equal, both being self-powered and tracked.

Two Drillmaster rigs and a smaller air track working side by side.

Minimizing Electrical Costs in Factory Buildings

The first cost of a factory's electrical system may amount to as much as 20 per cent of the total building cost and electricity consumption may account for up to 5 per cent of the cost of the product of the factory. And electricity consumption in factories is still increasing.

For these reasons the Building Research Station undertook a study to determine the cost factors involved in electrical installations within factories and the results are contained in *Electricity Supply and Distribution*, Factory Building Studies No. 10, published for the Department of Industrial and Scientific Research by HM Stationery Office (*3s 6d*, by post *3s 10d*). It is emphasized in the report that mere planning for minimum first cost can be deceptive if no allowance is made for flexibility that might be demanded by changes in plant layout. If no such allowance is made, the cost of alteration to the electrical system may be greater than that of the original installation. It is noted that the importance of flexibility is increasing as technical change proceeds. Except under special conditions, private generation is not recommended.

The booklet is meant for management and the building designer; for the first to provide a "comprehensive initial reference for briefing the specialist consultant" and preparing and checking factory budgets, and to the building designer so that he can be aware of the planning provisions that should be made. Most terms are explained or defined so that little or no prior knowledge of electricity is required to follow the recommendations. Two very useful tables give average electrical load densities (in kVA per 1,000 sq. ft) for factories in a variety of industries; and the second gives the load density required to provide lighting levels of 20, 30 and 50 lumens per sq. ft over the production area.

Subsequent chapters discuss distribution systems and circuits, wiring systems and the improvement of power factor by reducing the inductance of the installation. For low-speed drives, especially if large motors are required, synchronous motors are suggested; alternatively, where the tariff includes some form of low power factor penalty, the installation of capacitors is said to save their cost in the first two or three years. The booklet concludes with a brief reference to the statutory requirements for electrical installations in factories.

Automatic Batching Plant for Pre-Mixed Concrete

The growth in the use of pre-mixed concrete has been one of the features of the building industry of recent years. Now Ready Mixed Concrete (London) Limited have brought into operation a most elaborate automatic continuous batching and mixing plant having an output of 3 cu. yd of mixed concrete per minute. The new works is located on the north bank of the Thames adjacent to Wandsworth Bridge in London.

Incoming aggregates can be received by either road or river. A series of power driven elevators take the stone to high level storage bins which have a combined capacity of 1,500 tons and permit up to seven different types of aggregate to be stocked. A weigh-belt feeder runs below the mouth of each hopper and measures the quantity of aggregate delivered to the mixer. The weighing device compensates for variations in the rate of flow by increasing or restricting the opening through which aggregates issue.

Cement is delivered in pressurized lorries and is blown into the storage compartments; four cements can be stocked, the total capacity being 120 tons. Cement is batched in a similar manner to the aggregates, except that a screw conveyor is used to feed the material on to the belt weighers. Water to the mixer is controlled by a solenoid operated stop valve and regulated by a graduated quick acting valve. Provision is made for the addition of liquid additives.

A central control panel carries a setting dial for each material. Setting the dials adjusts the speeds of the belt weighers so as to give the required mix at the batcher. The equipment incorporates safety interlocks which ensure that should the flow of any one of the materials change or fail, the cycle will automatically close down and at the same time give a record of the quantity of concrete produced. All the aggregate feeders can be adjusted for variations in moisture contents.

Ready Mixed Concrete Limited, 2-3 The Sanctuary, London SW1.

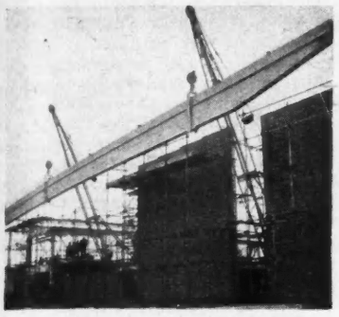
(*Left*) *Ready Mixed's new London plant.*

(*Below*) *Aggregate storage section, showing the feeders for the seven aggregates stored and the batch conveyor.*

Glulam Beams 100 ft Long

Glued laminated timber beams, believed to be the largest in Europe, are being used in a building for an ice rink in Leeds.

There are seven of these beams, which are 100 ft in length and weigh 5 tons each. Their



effective span is 97 ft and they are spaced at 24 ft centres. The secondary beams between them are of plywood web construction.

To lift each beam into its final position, two Jones KL 66 cranes have had to travel up a ramp 30 ft long with a gradient of 1 in 8 to reach the floor of the building. Both cranes worked in unison to raise the beams from the transporter and place them in position.

Both the laminated members and the ply-web beams have been fabricated by Kingston (Architectural Craftsmen) Limited, of Hull, to designs by Mr. Ian H. Paxton, consulting engineer responsible for the roof structure. The architects for the ice rink are Gillinson and Barnett, of Leeds.

Soil Mechanics in NE Region, BR

British Railways, North Eastern Region, have recently opened a large extension to their Soil Testing Laboratory at Leeman Road, York. This adjoins the main building of the newly completed concrete depot, and follows the introduction last year of a mobile soil testing laboratory, the first of its kind to operate on British Railways.

Soil testing proved its value, and saved money, in the construction of the concrete depot. The site was on alluvial soil and 50 ft piles would have been needed to make a good foundation for the main building. It was found, however, that filling material from a site at Poppleton, near York, with a suitable degree of compaction, provided a good foundation without resorting to the expense of piling.

Aluminium Interlocking Facing System

A complete system of decorative ribbed facing for building surfaces is provided by nine extruded sections in an interlocking facing system developed by James Booth Aluminium Limited. It will be particularly suitable for wall linings, canopy soffits, or as in-fill panelling in curtain walling.

The nine sections will be stocked in standard 16 ft lengths, but any other lengths may be supplied to order, and the widths range from 8 in for the standard panel to approximately 2½ in for the end stop. The extrusions include: the standard panel, spacer, end stop, expander, joint cover, outside and inside corner, cap/cill stop and intermediate panel. The expander, cover joint and spacing sections allow the standard panels to be fitted to any length of wall and the ancillary sections ensure continuity of fittings over varying angles and apertures.

The natural finish is a ribbed aluminium facing, which may also be supplied anodized. It may be fixed direct to timber or plugged to masonry, and self-tapping screws are advised for fixing to steel.

Pipe Strains After Laying

To find out the types of strains that are reached in a pipe after it has been laid, short lengths of 6 in diameter gas main were installed in the premises of the British Cast Iron Research Association. A study was made on the amount of strain induced in the pipes by the laying operation; the amount of strain induced in the pipes by soil movement developing after laying; and the amount of pipeline movement with time. The results of the investigation have been published in "The Determination of Stresses in Buried Pipes," a paper presented by H. H. Collins, G. N. J. Gilbert and R. Rew of the BCIRA, to 27th autumn research meeting of the Institution of Gas Engineers, held in London, 21 and 22 November, 1961.

Foil gauges were chosen to measure the strain induced in the pipes, and these were fitted to six pipes laid to cover many of the conditions encountered in practice, including: the relatively stable conditions existing in an undisturbed field, conditions of moderate subsidence, various loadings due to road traffic, and the severe case when the pipe is supported only at the ends by rigid structures.

The lateral and vertical movement of the six individual pipes was directly determined by measuring the angular displacement of the pipe centres relative to massive central points.

Ten active gauges were fixed on in approximately the centre of each pipe, using Araldite strain gauge cement. From the positioning of the gauges it was possible to estimate the amount of longitudinal strain from vertical loads, the circumferential strain due to ovality caused by uneven soil pressures, and the horizontal strain component.

It was found that the greatest stresses were transverse stresses introduced into the pipe during laying and during settlement after laying. Circumferential stresses were relatively small.

A bending failure would be due to the longitudinal tensile stress exceeding the strength of the pipe material, and the failure would occur with a circumferential crack. In the range of tests carried out, no tensile stress exceeded 3 tons per sq. in, which is small compared with the 20 tons per sq. in tensile strength of the pipe material. Even this stress of 3 tons per sq. in was found only in the pipe laid in an abnormal way, purposely to induce high stresses. For pipes laid in the normal way the maximum stresses were considerably less and frequently fell after laying, due to consolidation.

There was a sharp increase in the longitudinal bending tensile and compression stresses when power-rammed earth compactors were used to consolidate the soil and complete the laying operation. These stresses were further effected by the state of the trench surface. The level of stress that was induced during the laying operation was roughly the level that persisted subsequently. The stress level in pipe regularly crossed by a moderate amount of heavy traffic increased slowly due to uneven consolidation.

The amount of movement of the pipes was negligible, except in areas liable to subsidence.

Waterproof Sandwiches for Flat Roofs

An alternative method to the traditional roll cap method of roofing has been introduced by the Nuralite Company Limited, Gravesend.

As a result of several years research by the British Uralite Group at Higham, the technique has been developed for contemporary flat roof construction. To be known as the Twinrib system, it is based on an impermeable, weatherproof sandwich form of jointing, utilizing standard 8 ft by 3 ft Nuralite sheets. It has a range of application from falls of 1½ in in 10 ft up to a pitch of 40°. Provided it is applied in accordance with the instructions given in the company's handbook, there is a 25 year guarantee.

Nuralite is a thermoplastic asbestos-bitumen material of laminar construction. It was developed during the war as an emergency covering for aircraft hangars, and was introduced into the building trade ten years ago as a substitute for lead and other materials then in short supply.

Nuralite Company Limited, Whitehall Place, Gravesend, Kent.

Composite Construction in Floors and Walls

An interesting example of the use of composite construction to meet practical considerations of head space and floor load capacity is found in the new head office of William Deacon's Bank Limited, in Mosley Street, Manchester.

The building, which is seven storeys in height, uses composite floors throughout. To develop the composite action 8,740 "Cromp-Arc" stud-welded shear connectors supplied by Crompton Parkinson (Stud Welding) Limited were used. In addition to their conventional use of providing composite action between the concrete floors and the steel beams, the shear connectors were also used on the flanges of the wall beams to provide a bond between the steelwork and the *in situ* concrete walls. The design included elongated attachment holes in the wall beam cleats which ensured that, after the concrete had been poured, the beams could be adjusted vertically to maintain full area contact between beam and concrete, and that the concrete anchors were fully submerged in the concrete.

Six Lane Motorway on Reclaimed Land

The ring of hills enclosing the fine harbour of Wellington, capital city of New Zealand, leaves little space for the large and growing volume of road and rail traffic from the city to the rest of the North Island. The present four-lane highway that winds round the foot of the hills on the left of the photograph is already inadequate for the 30,000 vehicles that use it each day and work is proceeding on reclamation from the sea of a strip 130 ft wide and 2½ miles long, which will carry a six-lane motorway. The estimated cost

is £3,500,000. The amount of filling required is 2¼ million cu. yd, and for protection against wave action 70,000 cu. yd of rock will be necessary. Completion is due March, 1966.

In the note "70 ft Deep Under-Reamed Piles" last week (p. 675) we omitted to give the name of the consulting engineers, who are A. E. Beer and Partners, 96 St. George Street, London, SW1.

The Fight Against Industrial Fire

Fire risks multiply with the development of industry, and the resulting toll of damage calls for wide appreciation of both old and new aspects of this hazard.

As well as being the original natural ally of mankind, fire has from the first been a treacherous slave and an elemental enemy of premier magnitude. It has found a way to threaten every new development throughout history; and as civilizations became more ingenious and more intricate technically, so the universal fire hazard became more complex.

From Classical times, water has been held to be the natural enemy of fire, and this acceptance for the basis of fire fighting held unrivalled sway until quite recently. When the chemical properties of substances became better appreciated and new compounds were introduced, with simultaneous advances in quantity production, many new methods of tackling fires became feasible. This was, of course, just as well, since the collateral growth of technology outside fire fighting had multiplied the risks of fire. But the unknown dangers created by these new potentials of industry were accompanied by the age-old factor of the unsuspected simple causes of outbreak. The unexpected therefore continues to give the flames a favourable start, and to the time-honoured watchwords of vigilance the scene today must claim ceaseless research as well, to outwit this enemy on its many fronts.

DANGER AND DAMAGE

The susceptibility of industrial buildings to fire damage requires a special study in itself. The Fire Protection Association, reporting on large area factory fires last year, drew attention to the common feature of many recent outbreaks as being lack of fire separation, which resulted in an extensive factory area throughout which a fire was free to spread. Soft fibreboard roof linings and heavy coatings of bitumen, roof trusses and supports not protected against the effects of the heat of a fire, and thus liable to collapse in its early stages, were features frequently associated with these disasters. The report stressed that automatic sprinkler systems provided the most efficient means of countering the hazards of a large undivided area. Water is still playing a leading role in combating flames, even in this age.

Mr. W. A. Jackson, home fire manager of the Royal Exchange Assurance, gave his opinion in October, 1960, that hundreds of acres of factory roofs in Britain ought to be broken up because of their inflammability. One effect of an Order made by Mr. John Hare, Minister of Labour, in the same month, was that owners and occupiers of more than 220,000 factories in Great Britain subject to the Factories Acts would have to provide adequate fire fighting equipment; and his Ministry published a booklet in February this year entitled *Fire Fighting in Factories* giving advice concerning types of equipment required by law to be installed. The fire brigades of this country deal every year with between 7,000 and 7,500 outbreaks in industrial premises; material losses from these fires and the smaller ones extinguished by factory personnel account for over half the total annual fire damage, with more than 100 persons killed or injured.

HAZARDOUS PLACES

The *Fire Protection Bulletin* 1959-60 had discussed the fire hazards and precautions in metal working industries—in finely divided form, as dust or swarf, metals can burn readily, and combustible materials used in the processes can spread the fire. The *Bulletin 1960-61* set out some fire precautions for builders and structural engineers which should be observed during repairs, alterations and new construction. Special hazards could arise where blowlamps were used for paint-stripping, and wherever possible, a non-flammable paint stripper should be employed. Cutting and welding should only be undertaken when combustible materials were well out of the way; the heating of bitumen over an open flame demanded constant supervision, and the use of flammable liquids in adhesives for tile laying, for paint thinners and cleaning solvents needed particular watchfulness, as the vapours could travel far from the point of origin. Temporary heating, electrical installations, smoking and waste and refuse disposal were other sources of potential danger.

Mr. R. E. S. Whillock, A.M.I.Fire E., assistant divisional officer, London Fire Brigade, in a talk given at a general meeting of the London Building and Engineering Contractors Accident Prevention Group on 15 March this year, commented on the opportunity which the Factories Act of 1959 had given for fire brigades to take part in the improvement of fire protection arrangements in factories, other than by way of advice on requests from factory occupiers and owners. Concerning fire precautions in high buildings under construction, Mr. Whillock said it was desirable to install dry or internal wet rising mains as the building itself was increased in height.

The risks associated with fire in the youngest technologies can take unusual forms. As early as 1956, Mr. D. I. Lawson, M.Sc., M.I.E.E., F.Inst.P., had given a survey entitled "The Fire Hazards of Radioactive Materials" to Manchester Insurance Institute. "Radioactive materials themselves are not more flammable than their non-radioactive counterparts," Mr. Lawson pointed out, but "the only difficulty is that they may be dispersed by fire, and either the materials themselves or the radiations they give off will be absorbed in sufficient quantity to give rise to certain biological effects." In considering what steps may be taken to avoid dispersing radio-isotopes in fires, recommendations were then made for the specific circumstances which could arise in Government research laboratories, nuclear power stations, industrial and chemical research laboratories and during transportation.

METHODS AND RESEARCH

Water has asserted its value in modern fire fighting techniques for purposes which may have come to seem surprising. A paper by D. J. Rasbash and Z. W. Rogowski, published in 1958 and describing work forming part of the programme of the Joint Fire Research Organization of the Department of Scientific and Industrial Research and Fire Offices' Committee, dealt with the extinction of fires in burning liquids by cooling with water sprays. It was inferred that, in the tests on which an equation relating extinction time with the spray and fire properties was based, cooling took place as a result of heat transfer between the oil and the water drops. Equally revealing, though, is the fire hazard of water itself—in the presence of highly reactive metals, certain chemicals, and hay, it can cause or aid the spread of fire.

A jet engine has been adapted at the fire laboratories of DSIR to project inert gas into the seat of a fire, and so extinguish it by cutting off the air supply. The Pyrene Company Limited, a famous name in the field of fire fighting, today offer a wide range of CO_2 fire extinguishing equipment both in portable forms and as fixed installations which can comprise a battery of large-capacity cylinders linked to a distribution system covering a wide area—such as a power station or the cargo holds of a ship. These installations can be operated automatically from Pyrene fire detecting equipment. This company also supply many types of foam extinguishers, one of which, model RFU1, consists of a steel container filled with foam-making compound, and which can be connected to a water hose reel converting it in seconds into an effective foam producing unit for quenching highly inflammable materials. Other Pyrene foam installations are designed for fitting to bulk oil or spirits storage tanks.

Nu-Swift Limited have put much research into evolving a range of pressure-charge operated extinguishers suitable for many different types of fire. Based on the belief that the more conventional soda acid machines have certain drawbacks—amongst which the need for frequent re-charging to maintain efficiency is prominent—this company have designed units containing CO_2 under pressure, always ready to expel high-pressure water, "wet water," air foam, carbon tetrachloride, chlorobromomethane or dry powder.

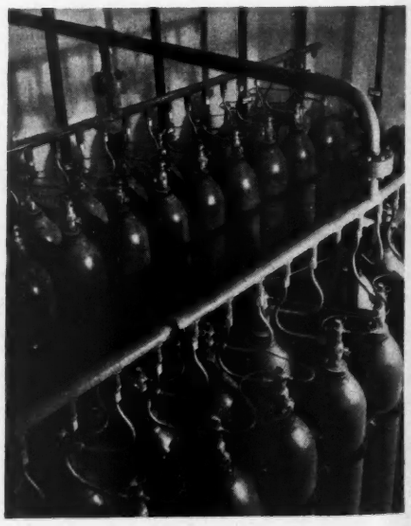
DETECTION MEASURES

Pyrene have also developed an automatic fire detecting and alarm system which will meet the demands of any fire risks regardless of size, area or the number of buildings involved. This system utilizes an ingenious technique in which open circuit detector heads are installed in a two-wire design for continuous circuit supervision, using pvc covered wiring enclosed in steel conduit. Sound Diffusion (Autothermatic) Limited, last year installed what was then hailed as a record order for fire detection equipment to the value of £28,600 at the Merthyr Tydfil plant of Hoover Limited. The manufacturers claim that this system will detect any fire in a matter of seconds in any one of 38 factory zones.

The importance of communication in fighting fires from mobile appliances was brought out typically by the development of a wireless and salvage tender by Merryweather and Sons Limited for the Kingston upon Hull fire brigade. The front compartment of this tender provides a wireless table for the driver and officer.

CONSTRUCTION CONSIDERATIONS

Test facilities have been provided in the Fire Research Building of the Division of Building Research of the National Research Council, Ottawa, to determine the fire endurance period of walls and floors. As Mr. G. W. Shorter and Mr.



A typical Pyrene CO_2 fire extinguishing installation for the protection of power stations and sub-stations. This pressure-operated system is manifolded to pipelines terminating in gas discharge heads at various fire danger points. Manual or automatic operation may be incorporated.

T. Z. Harmatty pointed out in the division's *Fire Study No. 1*: "When a fire occurs in a building, at an early stage it is generally confined to a single compartment. A major disaster can therefore be avoided if the walls, floor, and other elements of this compartment are so designed as to prevent the fire from spreading to other compartments."

At the new laboratories of the Fire Research Station, Boreham Wood, teams are now working on completely new techniques to improve fire protection in industry, particularly in view of the growing number of large fires in factories which lack adequate fire breaks. Mr. S. H. Clarke, C.B.E., M.Sc., director of the Warren Spring Laboratory of DSIR, made the point in a Royal Society evening discourse last year that an immediate aim of fire research was to find means of scaling down experiments (in contrast to chemical engineering, where the aim is scaling up), because of the costly and time-consuming nature of full-scale investigations.

STRUCTURAL RESISTANCE

The fire resistance of basic structural materials has received a great deal of attention over recent years. In a paper published by the Institution of Civil Engineers in September, 1960, Mr. L. A. Ashton, B.Sc.(Eng), Chief Experimental Officer, Joint Fire Research Organization and Dr. S. C. C. Bate, A.M.I.C.E., Principal Scientific Officer of the Building Research Station, presented the results of an investigation on the design of beams for buildings of high fire risk, such as large warehouses, where a fire-resistance of 4 hours would be required for structural elements. It appeared that, for normal forms of composite prestressed concrete beams used in floor construction, resistance is governed by the protection given to the prestressing steel. For hard-drawn steel wire, a cover to the cable of 1½ in of concrete was sufficient to give a fire-resistance of one hour, and for longer periods secondary reinforcement was necessary to hold the concrete cover in place; a cover of 4 in gave a fire-resistance of 4 hours, and by further increasing the concrete cover, fire resistance of up to 6 hours might be obtained.

British Standard 476: 1953, "Fire Tests on Building Materials and Structures," lays down the essential conditions of fire resistance for the design of structural members of buildings. These requirements have formed the guiding principle in the fire protection of structural steelwork, for example, and vermiculite plasters have been used very successfully in this field. As a case taken at random, Pyrotherm (Tomkinsons Investments) Limited supplied more than 15,000 sq. ft of Pyrotherm vermiculite for the new British Home Stores building in Crewe. The 1 in precast sections, giving a two-hour fire rating to comply with BS 476 Part 1: 1953, were fitted to the beams by means of stirrups over the top flanges.

Asbestos is also used to protect structural steel beams and columns, and structural concrete beams, and Turners Asbestos Cement Company Limited have developed "Turnall" asbestos insulation board and sprayed "Limpet" asbestos for these two materials respectively, in accordance with the Model Building Byelaws and BS 476/1953.

CONTROL AND PREVENTION

The DSIR report of their activities at the Building Exhibition, Olympia, 15 to 29 November this year, referred to the restriction of the spread of fires in modern factories. Serious fires had occurred in buildings where fire resisting walls could not be built because of the need to accommodate production lines, and these outbreaks were largely due to the rapid spread of hot gases, which could help the development of a fire, especially at roof level. Under these circumstances, fire fighting is frequently hampered by dense smoke, which obscures the seat of the fire. The Joint Fire Research Organization in conjunction with Colt Ventilation Limited had carried out research to show that the accumulation of dense smoke and the spread of fire may be restricted by opening properly designed vents in the roof, and that the effectiveness of the vents could be increased by the use of solid curtains to divide the roof into compartments.

These findings, and the value of the Colt ventilator, which opens automatically at a predetermined temperature, were confirmed during a Brains Trust which followed the première of the Colt film "Fire Control in Industry" on 22 November last at the Building Exhibition. This discussion, in which eminent industrial fire officers took part together with building research and equipment specialists under the chairmanship of the Director of the Fire Research Station, Mr. D. I. Lawson, M.Sc., M.I.E.E., F.Inst.P., was notable for its vivid and impressive first-hand accounts of fire-fighting in recent practice—into the unassuming relation of which one could unmistakeably divine the heroism for which firemen are famous.

Mr. A. Whitehouse, Chief Fire Officer, Rootes Group, said that his experience substantiated the use of automatic ventilation and truss infill, but it was important that these should not upset the day-to-day needs of ventilation or interfere with natural lighting and overhead conveyors. Another score to take into consideration was the change in stock loading from one day to another due to widespread palletization methods. It had been necessary to train all his fire crews in the use of fork-lift trucks, as during a fire, it was essential to break the stacked mass down as it had been built up.

PRACTICE AND PRECEPT

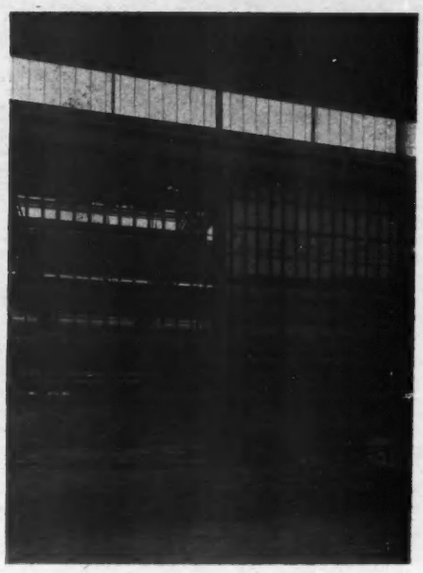
Mr. W. H. Webb, M.B.E., Chief Fire Officer, Goodyear Tyre and Rubber Company Limited, and Vice-President of the British Fire Services Association, was also a firm believer in ventilation, with particular reference to rubber fires—it was impossible for firemen to work, he said, in the thick smoke evolved. Mr. Webb also mentioned that Goodyear have laid down a standard building practice for their storage facilities, specifying materials and layout. During the questions which followed the talks from the panel, Mr. E. L. Bird, M.B.E., M.C., A.R.I.B.A., technical research and education officer of the Building Centre, dealt with the problem of fires in multi-storey buildings—it had been agreed that though there was a need for ventilation here, the automatically opening ventilator was not suitable, though ideal for single-storey structures. Mr. Bird referred to the value of lifts from which firemen could work at various levels, and drew attention to the hazard of conveyor lines which come through floors: it was now customary to seal these off by water spray—a method described in a recent Fire Protection Association publication (*Bulletin No. 10*, in underlining the importance of fire separating walls in factories, also shows how openings made in the walls for conveyors may be protected against the passage of fire and smoke).

Closing the discussion, the chairman stressed that roof ventilation of fires was not an excuse for lack of fire prevention throughout a factory: it would increase burning at ground level once a fire had passed its initial stage.

SIGNS OF PROGRESS

There can be few fields where it is more needful to apply the positive results of research with greater urgency than is the case with the development of fire prevention techniques.

An illustration of the way in which checks on extended applicability can be carried out, with relation to certain fire test equipment and the determination of its accuracy, is provided by a paper by Mr. E. H. Coleman, F.R.I.C., dealing with a research programme undertaken by the Joint Fire Research Organization and published in *British Chemical Engineering*, July, 1960. Reviewing the performance of portable explosimeters developed to measure the concentration of flammable vapours, it is shown here that though there are statutory requirements for the accuracy and reliability of instruments intended for use in coal mines, there are none for instruments intended for general use. Because of this and a lack of information about the accuracy of explosimeters, three instruments intended for industrial use were examined. The two filament type instruments were found to be sufficiently accurate for use in hazardous flammable vapours, while the third type—a flame lamp alarm—was found reliable for such limited applications as sewer gas detection and solvent ventilation checks.



Fire resistant partitioning being installed at the new Hereford plant of Henry Wiggin and Company Limited. It has a strong, light Unistrut frame, faced on both sides with Asbestolux.

OUTLOOK FOR SECURITY

The demand for alertness towards insidious danger is accentuated yet again on the count of supposedly fireproof conditions containing in fact some vulnerable feature, which, in the lulled vigilance of a sense of security, can represent a risk magnified ten-fold. These chinks in the brave armour are as threatening as yet uninvestigated threats. In an address to the Royal Institution of Great Britain in October last year, Mr. S. H. Clarke, C.B.E., M.Sc., referring to the serious magnitude of the effects of fire in this country recently, associated himself with the view that many of the fires and much of the damage might have been averted if existing knowledge had been applied in time. "Nevertheless, the largest fire of modern times—perhaps the largest single fire of all time—occurred a few years ago in a modern building which had been assessed by experts as fire-resisting. One of the main aims of fire research is to protect against the hazard of future fires in a rapidly advancing industrial world which makes ever new and greater demands."

Traps for the unwary are to be found in instances where familiarity has engendered listless acceptance—the very domestic fire itself is a compelling example here: flames which mean so much for comfort and use are hard to think of as being potentially cruel at the same time. Similar might well be said of articles of apparel, which when inflammable, as they all too frequently are, can exchange their beneficent protection for a death trap. Snares of this sort in industry as well will only be reduced in number if there is much more readiness to think one step further, of what might happen—a strong argument for imagination as well as science.

National Fire Prevention Week, which was held from 30 October to 4 November this year, emphasized the need for greater awareness throughout the country of the fire threat. Publicity concerning the nature of fire in modern society and industry is imperative if the community as a whole is to be usefully and literally alive to the shapes, usual and unusual, which this hazard continually presents.

FACTORY EQUIPMENT EXHIBITION

Earls Court, London, 13—18 November

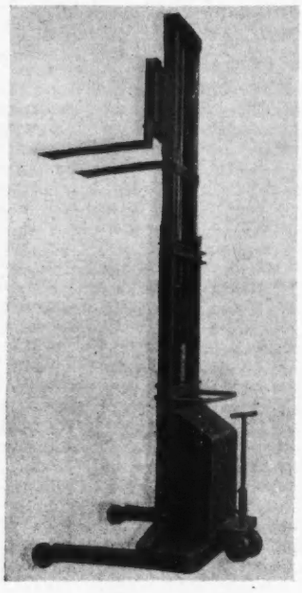
THE INTERNATIONAL FACTORY EQUIPMENT EXHIBITION, which recently concluded, contained the products of some 350 firms. The exhibition enjoys the support of over 250 associations, institutions and societies, representing every branch of factory equipment; as would be supposed, the exhibits were of a comprehensive nature. Equipment in the widest sense of the word was included, from finance onwards. Divided for the first time into groups corresponding to major divisions of the industry, no less than 14 sections were required to include the many needs of modern industry.

Among the prominent features was the international aspect of the exhibition. Much foreign-made equipment was on show and much overseas interest was apparent. Another noticeable aspect was the equipment now available which is offered to make the factory a better and more attractive place in which to work; this in addition to the continuing trend to make each job one more easily accomplished. In the former connection a section was devoted to canteen equipment, general welfare, and automatic vending machines. A further feature of this year was the parades of protective clothing and personal safety equipment. Accompanied by a commentary, these shows were of value to those responsible for the selection of such clothing.

The units described on this and the following page have been selected from the many new items which were on exhibition.

ELEVATOR TRUCK

Intended for Static Application



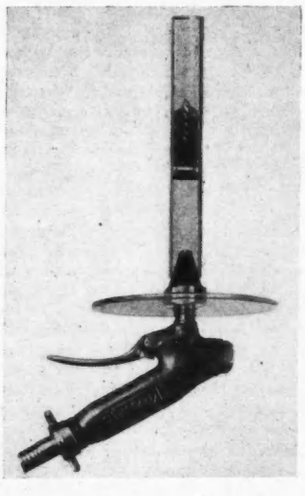
KNOWN as the Vertolifter Series VTRT/1500 elevator truck, the model extending to a height of 170 in is a new addition to the Powell manually-propelled hydraulic-lifting units. It is intended for vertical rather than horizontal transport.

Features of this truck are twin roller-type lifting chains, telescopic masts, side thrust rollers for masts and fork carriage, box-section outrigger legs, and needle or roller bearings for the wheels, rollers, and chain pulleys. Capacity is 1,500 lb at 15 in load centre, 1,250 lb at 18 in, and 1,125 lb at 20 in. The forks, which have a length of 33 in, are adjustable laterally. Lifting speed is 12 ft per min. Lowered the height is 105¾ in.

Two wheel arrangements are offered. The type HHR has two outrigger wheels and two rear swivel castors. The type PPH (illustrated) has, in addition, a steering unit, the castors being provided for stability. *Powell and Company, Burry Port, Carmarthenshire.*

TUBE CLEANER AND BURNISHER

Employs Bullets



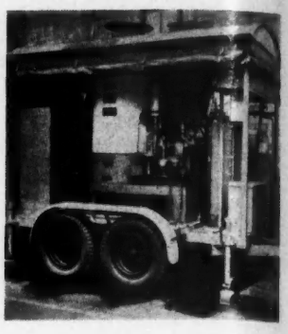
THE Keza tube cleaner and burnisher is a compressed air gun which propels bullets through tubes, from ¼ in diameter, of condensers, and such units as oil coolers, and delivers waste matter at the far end of the tube.

It is claimed that this method of cleaning is suitable wherever the deposits are of a sludge-like nature. Maintenance is reported to be minimized and the bullets are said to have a long and efficient life. The bullets take various forms; the standard one is of crimped brass wire, also available are nylon bullets, coil type scraper bullets, and combinations of coils and bristles. Protected noses can be fitted to the standard and nylon bullets, to lessen impact at the point of exhaust.

The minimum air pressure required to operate the gun is 70 lb per sq. in, but higher pressure is advantageous. Normal operational speed of the cleaning unit is 3,000 to 4,000 ft per min. Cleaning is carried out a tube at a time, the rate being determined by the speed of the operator. The tubes to be cleaned may be straight or continuously coiled. *Kleen-e-ze Brush Company Limited, Hanham, Bristol.*

MOBILE STEAM GENERATOR

Rapid Steaming



MODEL R050 Clayton mobile steam generators have a normal steam output of 1,430 lb per hour from feedwater at 60° F.

These generators are suited to supplying steam for any purposes within their capacity, either at temporary sites or as replacements in the event of failure of boiler plant. If required a number may be employed to produce high outputs. While these units are available for purchase they may also be hired. Claims made for the Clayton steam generator are ability to continuously deliver the designed output with less than 1 per cent moisture content, and to develop the full rated capacity within five minutes of starting from cold. The generator is stated to automatically recover from sudden peak or overload demands and to be able to maintain a minimum thermal efficiency of 75 per cent while operating at partial or full load.

Generators of this make are supplied to operate at pressures up to 295 lb per sq. in; the Model R050 fitted in the application shown, has a working pressure of 120 lb per sq. in. Fuel consumption is at the rate of 11·8 gallons per hour. Electrical supply requirements are 400 to 440V 3ph 50 c/s 4 wire. The maximum current demand when running at 440V is 8A. Feedwater must be of zero hardness, free from sludge, of sufficient alkalinity and oxygen control to eliminate corrosion, and must not contain more than 200 gr per gallon of dissolved solids. *Vulcan Foundry Limited, Newton-le-Willows, Lancashire.*

FACTORY MARKING MACHINE

Has Alternative Uses

STYLED the Hifflo HF50 Satellite, the marking machine illustrated is claimed to be suitable for marking factory gangways, car parks, marshalling yards and garages.

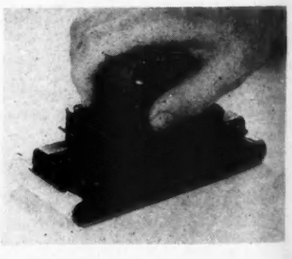
The machine is reported to be able to operate at speeds of from 40 to 60 ft per min. The spray gun is vertically mounted, an arrangement which is said to give uniform coverage and adequate painting of irregular floor surfaces. When straight lines are required the castor locking pin enables steering to be dispensed with. Line widths are stated to be quickly changed and lines of double width may be painted by traversing in opposite directions with the outside disc removed. Removal of this disc also enables edges of platforms or loading banks to be marked. It is possible to paint 3 in lines within 1 in of immovable objects.

A built-in cleaning system is operated by turning two taps, enabling the spray gun and pipelines to be cleaned under pressure without dismantlin c. If required, the unit can, it is said, be converted to a mobile paint sprayer or used as a portable compressor. The machine is powered by a 4-stroke I/C engine, but if required it may be converted to operate electrically or on Calor gas.

Capacities are: paint 6 pints, cleaner 1 pint, petrol 4 pints. Dimensions are: 35 in long, 37½ in high, 24 in wide. Special line requirements can be catered for. *Planet Holdings Limited, Watling Street, Bletchley, Buckinghamshire.*

AIR SANDER

Lightweight Orbital Type



THE Model OS800 Sundstrand air-operated sander has a single pad operating in an orbital direction.

Claims made for this unit are its compactness, lightness—it is stated to be the lightest on the market—and ability to reach into restricted spaces. Control is by means of a palm-operated lever. Operating on an air pressure of 75 lb per sq. in, and working at a speed up to 6,000 cycles per minute, the sander is reported to be free from vibration. It is said to remove material quickly, to be able to sand right up to edges and mouldings, and to be suited to rough sanding and preliminary finishing. Weighing 3 lb, it is claimed that the unit may be used without the operator becoming fatigued, a result contributed to by the provision of spring mounting.

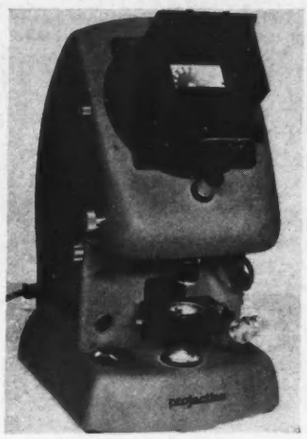
The single pad has a circular action of $\frac{1}{16}$ in. The size of the paper is 3 in by 8 in. Wet or dry sanding may be carried out, in the latter case it is necessary to provide a separate water supply. Machines are supplied with either sponge rubber or felt pad assemblies, fitted with quick-action clips for change of abrasive paper. The capacity of the paper clips is from 4 to 6 sheets, of abrasive paper, depending upon the coarseness of the grit.

It is recommended that the sander be used with a moisture trap, air cleaner, pressure regulator (if the available air pressure exceeds 80 lb per sq. in), and automatic lubricator; these and other accessories are available.

Oil-resistant air hose, fitted with re-usable end connections, is supplied in lengths of 15 ft. *Sundstrand Sanders Limited, Shipston-on-Stour, Warwickshire.*

MICRO-MEASURING INSTRUMENT

Capable of Projecting



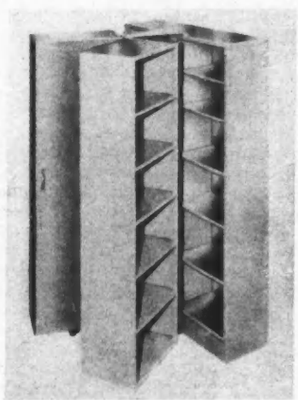
THE Swiss-built Projectina micro-measuring instrument will magnify from 7 to 3,000 times, projecting on to a ground glass screen, with simultaneous examination through a built-in eyepiece. Additionally it will project images on to a 2 ft by 7 ft wall screen.

Built-in lighting, together with simple polarizing equipment, allows transmitted and/or surface light, microscopy and macro/micro projection on bright or dark fields. The incorporation of two sets of optics, permits direct comparison of two specimens side by side on the same screen. This feature enables, for example, the uniformity of two identical or different strands of wire or yarn to be checked quickly and continuously with precision and without fatigue or eyestrain.

The illustration shows the instrument set up for photomicrography, which is claimed to be easily and quickly carried out with the aid of the accessories available. Photographs in the magnification range of 7 × to 2,000 × can be produced in 60 sec. The standard 4 in by 5 in double film holder and focusing screen are reported to be the most convenient to use. Adaptors are available for numerous cameras. *R. G. Macfarlane, 8 Montgomerie Terrace, Skelmorlie, Ayrshire.*

STORAGE AND FILING CABINETS

Reduce Stores Area



STO-DOOR steel cabinets or cupboards are claimed to save upwards of 50 per cent space.

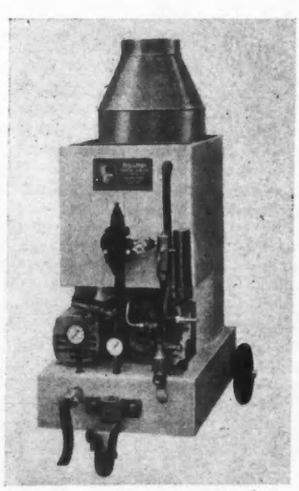
The unit comprises a static cupboard, the doors of which are themselves cupboards. It is claimed that these cabinets offer storage-at-a-glance visibility and hand-high accessibility. One unit is reported to be able to hold the contents of an 8 by 4-drawer filing cabinet at a lower cost and a space saving of 60 to 70 per cent. Cabinets, which may be locked, are internally arranged to comply with customers' requirements.

Suggested uses include the storage of tools, parts, clothing, records, and laboratory supplies.

The units are available in widths of 4 ft, 4 ft 6 in and 5 ft. Heights are 6 ft 7 in and 8 ft. Door depths which can be supplied are 9 in, 12 in, 15 in, and 18 in. Shelves are either welded in position or are adjustable, the method of fixing and the number of shelves being decided by the purchaser. Vertical divisions can be supplied and shelves may be replaced by bins or trays. Constructed from Zintec sheet steel, the units are stove enamelled with a choice of three colours. The maximum weight which a door will hold is 8 cwt. The static portion may be constructed to take any required weight. *P. D. Equipment Limited, The Basin, Barry, Glamorgan.*

STEAM CLEANER

Maintains Constant Steam Pressure



USING propane gas, the Magnus steam cleaner produces up to 60 gallons per hour of detergent-impregnated wet steam.

It is claimed that the burner may be lit within seconds, that an operating pressure of 100 lb per sq in is reached within two minutes, and that the unit may easily be handled by one man. Providing that sufficient oxygen is available for combustion, it is reported that the unit may be used inside. A built-in reservoir, with float control, maintains a constant supply of water to the heating coils and shuts off automatically when the machine is closed down. The detergent is kept in a separate 10 gal tank and fed to the reservoir through a metering valve, as required. Steam is generated in annealed steel heating coils having a diameter of ¾ in and a length of 110 ft. A diaphragm pump, operated by a ¼ hp electric motor, delivers water to the heater. Steam pressure is maintained at a constant and predetermined figure by automatic regulation of the gas.

The weight of the unit complete is 350 lb. *Magnus Chemical Company Limited, Salisbury Road Industrial Estate, Uxbridge, Middlesex.*

INDUSTRIAL VACUUM CLEANER

Handles Liquids

THE Model T331 vacuum cleaner has a six-stage exhauster and bag type filter.

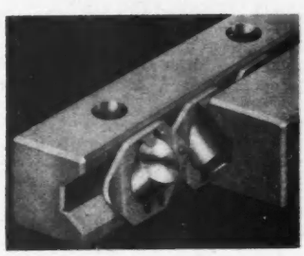
The example illustrated is fitted with a cyclone top and bucket, the bag filter acting as a primary interceptor. The separation system employed is reported to enable materials such as flour, cement, flue dust or soot, which would otherwise choke the filter bag, to be collected. When a ball check valve is fitted, the cleaner can, it is said, be used for drying wet floors, draining sumps, removing swarf laden coolant from machine tools, and handling fluids. When the machine is collecting material which could be injurious to health, a special final filter can be supplied to fit on the exhaust outlet which will, it is claimed, filter down to submicron range. For cleaning large floor areas a fixed floor tool can be used on the front of the machine.

Drive may be by a 3 hp electric, air, or petrol motor. The turbo exhauster runs at 8,000 rpm. The filter consists of a 36 in by 15 in diameter vertical container enclosing a twill filter bag of 2¼ cu. ft effective capacity. The hose entry will take a 2 in or 1½ in hose. The maximum air volume at the exhauster is 190 cu. ft per min, and the closed vacuum approximately 92 in wg.

For collecting flux from continuous welding machines a model provided with a reinforced cyclone top and wire mesh basket to separate the larger pieces of slag, can be supplied. *British Vacuum Cleaner and Engineering Company Limited, Goblin Works, Leatherhead, Surrey.*

BALL AND ROLLER LINEAR BEARINGS

New or Repair Uses



SETS of ball and roller linear bearings, manufactured in Switzerland, are now available in a range of sizes in Britain.

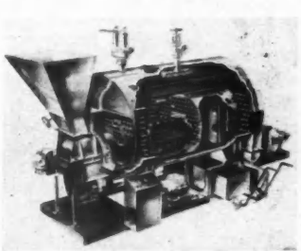
It is claimed that these bearings, with their low frictional losses, will outlast conventional slides. When replacement is necessary it is said that they may be simply and relatively cheaply replaced. It is reported that use is not restricted to new plant and equipment but that these bearings may be fitted to existing machines. Tracks of four types are available: the illustration shows tracks with crossed roller cage or chain; other types have tracks with caged balls, tracks with cageless balls, and, in the case of recirculating units, crossed roller chains are provided. The recirculating bearing has been produced to meet requirements when a slide has a long stroke in relation to its length; it is claimed to be particularly advantageous where the slide is itself shorter than the stroke and where very long strokes are required.

Tracks are made for both medium and heavy duties, and are available in two tolerances standard and close. Tracks are hardened right through to a ball-bearing Rockwell hardness of 62-HRC; they are reported to be stabilized for rigidity of shape. Vertical applications may be made but these are matters for discussion with the makers. In addition to the standard range, types are manufactured to meet customers' requirements, ranging from units used by the instrument industry to heavy-duty bearings carrying hundreds of tons at long strokes.

Fixing holes, put in during production, are standard or to requirements. *Engineering and Scientific Equipment Limited, 287 Old Street, London EC1.*

AUTOMATIC COAL-FIRED BOILER

Meets Load Variation



THE cut-away illustration shows a coal-fired boiler recently introduced by John Thompson. Equipped with coal and ash handling facilities which require periodic attention only, the boiler is claimed to offer operating advantages hitherto associated with oil-fired boilers.

Fitted with a wet-sided, dry-backed combustion chamber, the gas circuit is arranged to give three passes. The layout is claimed to allow efficiency over 80 per cent to be easily attained and, in conjunction with the corrugated flue, to provide the maximum radiant heating surface. A minimum of attention is said to be necessary; on the smaller boilers in the range the ashbox and stoker hopper give four hours unattended steaming on normally-available fuel. While the standard model is designed to be fired by a Mini-Stoker chain grate stoker, the boiler can be supplied with any coal handling arrangements.

Firing rate may be selected to meet anticipated load; change over between low and high rates is automatically effected by boiler pressure. Automatic control gear is supplied with the boiler. Fuel bed thickness is governed by an adjustable guillotine. When the unit is supplied as a completely integrated one, an elevator for hopper filling is included. Of all-welded construction, the boiler has a fusion-welded shell, manufactured as a Class 1 vessel. The flue tube is welded in at both ends; smoke tubes are expanded into the plate and seal welded.

Sizes range from 3,000 lb per hr up to 10,000 lb per hr F and A 212° F. Working pressures are 110 or 145 lb per sq. in. *John Thompson (Wolverhampton) Limited, Ettingshall, Wolverhampton, Staffordshire.*

Basic Research into the Human Factor

Management thinking on personnel and organization policies is too often founded on surmise and intuition. The basic researches of a body like the Acton Society Trust can provide a more scientific foundation for these policies.

SINCE the last war, industrial organization has become increasingly complex and, at some points, remote. There has been a parallel general awareness that management must undertake fresh thinking on personnel policies and organisation structures in the light of the new human and sociological situations implicit in this greater complexity and remoteness. Unfortunately, however, management has sometimes tended to base its thinking on surmise and intuition, instead of taking greater advantage of the basic research of people like the Acton Society Trust.

The Society was set up in 1948 by the Joseph Rowntree Social Service Trust to carry out social research, particularly in industrial and related fields. It is a non-profit making organization—working on the shoestring which usually accompanies this tag—and, through its trustees, is completely independent and non-political.

Industry is well represented amongst the twelve trustees through Mr. B. Philip Rowntree (the present chairman), Sir Jock Campbell, Mr. Peter Masefield, Lord Piercy and Sir Walter Worboys. This year, they have been joined by Mr. John Marsh, the new Director of the British Institute of Management. Another trustee is Professor T. E. Chester of Manchester University, a former Director of the Acton Society.

The most recent ex-Director is Miss Rosemary Stewart (she resigned in June of this year) and during her regime the Society adopted a policy of gradually replacing its grant from the Joseph Rowntree Social Service Trust with donations from industry and *ad hoc* research grants.

END-PRODUCTS

The most significant evidence and end-products of the Society's work are the reports published on research in the field. When this research work was begun, in 1948, one of the biggest current changes in industry was the setting up of large nationalised industries under the post-war Labour Government. This was a most interesting sociological phenomenon and became the subject of extensive research work by the Society.

Some of the work begun during this period and continued through the 1950s was on non-industrial organization, mainly in the hospital service. From 1955 to 1959, a description and analysis of hospital organization and administration under the National Health Service was published in a series of six pamphlets.

However, the majority of the Society's research work, and the majority of their published reports, have been on industrial matters, and these have made some important contributions to thinking on industrial relations and structures. For example, in 1953 and in 1957 the two parts of *Size and Morale* (3*s* 6*d*, each part) were published. Then, as now, this subject was an important and largely untouched field of study because so little was really known about the social relationship between industrial productivity and the tendency towards centralization.

Another significant report published during this period was *Management Succession* (10*s* 6*d*), which appeared in 1956 and was the result of a two-year research into management succession and development in fifty large private industrial firms. An indication of the extent and depth of the Society's research work is that the first part of this report analyses in detail the education and careers of over 3,300 managers. It evaluates such factors as " coming up the hard way," and holding a degree, and the aspects of a manager's background which tend to qualify or disqualify him for middle and top management.

Another report which was frequently praised was *Wider Shareholding* (8*s* 6*d*), published in 1959. It deals with small share investment in general, but its significance for management is its analysis of worker attitudes to owning shares. It helped—and is still helping—to clear up a number of misconceptions about the value and effect of employee share holding schemes.

Recognizing that redundancy problems are a fact of industrial progress and that such progress cannot be a healthy development unless these human problems are handled with sympathy and understanding, the Society produced two books on the subject—*Redundancy*, *Parts* 1 *and* 2 (5*s* each)—in 1958 and 1959.

Last year, the Society published *Retirement* (5*s*), an examination of the retirement policies and practices of over fifty large companies in relation to the economic, social and medical background of our ageing population.

NOTABLE FIRSTS

The most recent publication is *Management Initiative* (5*s*) (ENGNG., 24 Nov., p. 672), an investigation into management attitudes and reactions to change, and into the types of management structure equipped to assimilate change. It is an extrapolation from 32 case studies made in four companies.. Of these case studies, eight are due to be published in the new year in *Case Studies of Management Initiative* (16*s*), a volume which has been edited by Mrs. Elizabeth Sydney, now of the Institute of Directors. The individual case studies will also be available (2*s*). Like *Management Initiative*, it seems likely that the forthcoming publication will be of value and interest to managers generally and a useful reference book for education and training officers.

Now in the pipeline are reports on research into the role of the arts graduate in industry; management training, a critical analysis of selected courses; and the effects of mergers on managers.

The reports published by the Society have all contained original research findings of great value to enlightened management, and all have been at the forefront of management thinking at the time of publication. They have included some notable firsts. The term, " management succession," which is now part of the verbal armoury of every personnel officer, originated with the Acton Society publication of that name; the researches reported in *Wider Shareholding* were drawn upon by the Liberal Party in their 1959 election manifesto (though the Society itself, of course, is strictly non-political); and *Redundancy* foreshadowed (and covered in more depth) the Ministry of Labour's pamphlet, *Security and Change—Progress in Provision for Redundancy*, published last August. In the normal course of events, it seems, therefore, that one can assume that " management initiative " will become part of the technical jargon of personnel departments, and that the ground covered by *Retirement* will be covered again, in a year or two's time, by a government publication.

The publication of reports is not the only way in which the Acton Society's interest in social research is manifested. The Society staff are often asked to provide lectures and seminars, and to advise upon the arranging of management training courses. Each year, a conference of top managers is held at which the material discussed is not restricted to the findings of the Society's own research. In this sense the Society is a distributor as well as a producer of management ideas.

Now that the Society is evolving from the status of a financial dependency of the Joseph Rowntree Trust, it must rely chiefly on industrial firms for its income. At present, between forty and fifty firms (including some of the nationalized industries and, a status symbol if ever there was one, some of the banks) make annual donations of between five guineas and five hundred pounds. Grants are also received from the DSIR and other research organizations for specific purposes, but DSIR grants cover only the direct cost of research without overheads. Unfortunately, however, overheads do have to be met.

SUPPORT FROM INDUSTRY

The present evolution to the position of a financially independent body is very much an arrival at the cross-roads for the Society. If industry judges the work of the Acton Society to be a vital source of basic material for management policies (and it can judge that easily enough from the reports now available), then it must step up its financial support, and step it up quickly. The resources of the Society are too slender to withstand a long hiatus while firms decide whether to make contributions. If they do make contributions, these have to be made without strings, but such donations are recognized by the Inland Revenue as gifts to charity.

At the moment, all the work of the organization is undertaken by the deputy director, five research workers, a part-time secretary to the trustees and an office staff of five. The Society cannot afford to increase its staff, and most of its research workers could increase their salaries by more than 50 per cent immediately if they chose to move into industry. This means, unavoidably, that the staff turnover—about once every two years for junior research people—is faster than is good for the Society.

The Society is too small at present to take the " hills and valleys " in its stride, and is nearly as much afraid of startling success as of startling failure in a report. It would not be able to withstand the organizational strain of handling two " best selling " reports at a time, for example. On the other hand, if an anticipated contribution failed to turn up, it could put the society dangerously into the red. There is insufficient finance available to advertise the reports and yet, on the evidence of repeat orders for older reports mentioned in newer reports, it is clear that advertising would increase sales and, therefore, income. Increased donations would enable the Society to step outside this vicious circle.

All these factors place a great responsibility on the director (or, at present, the deputy director) to " pace " the organization evenly and to budget tightly on individual projects—a task which is extremely difficult with items of basic research lasting two or three years. The director must resist the temptation to go for the " flashy " job with the quick pay-off.

If donations from industry could be increased, the Society could enlarge its staff to cover a greater width of subject matter and to obtain greater flexibility in the disposition of its research workers. The Society could conceivably develop two separate divisions, for industrial and for non-industrial work, with donations from industry supporting industrial projects only but with a flexible movement of staff between the two divisions. In this way, the industrial and the non-industrial work would have a cross fertilizing effect on each other, but industry would be financing purely industrial research. Firms might then be more willing to make long-term covenants for donations, thus enabling the Society to plan ahead more confidently.

The Society is at the cross-roads, not only in its financial affairs, but also in the vitally important appointment of its director. This post has been vacant since Miss Rosemary Stewart resigned last June. Since then the acting chief executive has been the deputy director, Mr. Michael Kirton. The trustees have a red hot potato of a task in deciding who can meet the tough job specification of the directorship.

Acton Society Trust, 39 Welbeck Street, London W1.

Companies

Broom and Wade Have a Good Year

THERE is an absence in the preliminary statement of the trading results of BROOM AND WADE LIMITED for the year ended 30 September last of those pleasant announcements which have cheered their shareholders so often in the last few years.

Nonetheless, and especially in view of the difficult times through which the British engineering industries have been passing during recent months, the firm may fairly be regarded as having had a successful year.

For one thing, their total ordinary-share dividend for 1961 is being maintained at 22½ per cent, as was forecast in April last that it might be. The maintained final dividend (17½ per cent) is being paid, moreover, on a capital increased by a one-for-six rights issue made in that month. Previously, the total dividends on the ordinary shares had risen from 8½ per cent for 1957 to 22½ per cent for 1960.

Profits for the twelve months ended 30 September last amounted to £972,000 before tax, compared with £1,045,000 for the previous twelve months. Although this result represents a decline of around 7 per cent, it is still the second best in the group's history. Dividends, covered by earnings of nearly 24 per cent in 1958, by 37·7 per cent in 1959, and 42·5 per cent in 1960, are now covered by just under 35 per cent.

A Warning from English Electric

No longer ago than the end of last June, the board of the ENGLISH ELECTRIC COMPANY LIMITED, while acknowledging that it was then too early in the year for them, "in the light of present-day uncertainties," to forecast the profits for their current financial year, felt that they could, in the absence of unforeseen circumstances, expect to recommend a final dividend for 1961 at the same rate as the final dividend for the previous financial year. That dividend was 7 per cent, making 10 per cent for the whole year.

A warning that this result may not be achieved has been sent to the company's ordinary shareholders by their chairman, Lord Nelson of Stafford. He tells them that, while the results of the group for 1961 will not be known with precision until the latter part of February next year, the directors think it right to inform them that, although turnover has increased during 1961 and the volume of new orders overall has been maintained, there has been a further deterioration in profit margins, both at home and overseas.

Moreover, he says, the expected improvement in the affairs of D. NAPIER AND SON LIMITED, one of English Electric's subsidiaries, has not materialized. These factors, combined with the effects of the measures introduced by the Government in July, indicate that the profits for 1961 are likely to be appreciably lower than those for 1960. The amount of English Electric's final dividend for the current year will be determined at the appropriate time on a consideration of the final audited figures and the prospects for 1962.

Lord Nelson of Stafford and his directors are surely to be commended for this early warning of what may be the outcome of the present year's trading. Other British firms, alas, are also finding that maintained order books and higher turnovers are not necessarily being accompanied by maintained profit margins.

Speeding up Motor Car Deliveries

What is believed to be one of the largest road transporters in Europe for the conveyance of motors is now being used by the Coventry firm CANLEY CAR DELIVERIES LIMITED for the delivery of Standard-Triumph's new TR4 sports cars direct from the makers' factory to the docks, for export overseas.

For this purpose, Canleys are employing a specially adapted Leyland Super Comet truck with a trailer, which is capable of conveying ten of these cars at a time. Equipped by RUBERY, OWEN AND COMPANY, LIMITED, Darlaston, Staffordshire, the transporter is provided with a built-in Burtonwood hydraulic tail lift which is used to load cars on to both the two-deck trailer and the main three-deck truck.

The trailer was built locally by CARTER LIMITED, Tamworth, Warwickshire. The complete conveyance, when fully loaded, as shown in the accompanying illustration, weighs more than 18½ tons, and it has a length of 60 ft.

This Super Comet truck, manufactured by Leyland Motors Limited, Leyland, Lancashire, combined with a locally-built trailer, is being used by a Coventry firm for the transport of ten sports cars at a time, for direct delivery from factory to docks for shipment overseas. They form one of the largest vehicles in Europe to be used for transporting cars by road.

Mr. E. A. Barber, a director of Canley, stated recently that there is a possibility of his firm introducing a further six of these vehicles.

General Electric Company's Reorganization

Considerable progress has already been made in connection with the reorganization of the lighting and heating group and the installation equipment group of the GENERAL ELECTRIC COMPANY LIMITED. A further stage has now been attained by the formation of a new subsidiary company to merge the activities of these GEC groups.

To be known as GEC (LIGHTING AND EQUIPMENT) LIMITED, the new firm will possess manufacturing and other facilities at seven factories, situated in Birmingham, West Bromwich, Wolverhampton, Iver (Buckinghamshire) and Rickmansworth. The number of their employees will exceed 5,000.

The board of GEC Lighting and Equipment will operate from temporary headquarters in Newhall Street, Birmingham, until the end of the current year while, from 1 January, 1962, the headquarters will be located at Lloyd House, Birmingham.

Mr. John O. Sewell, who joined the General Electric Company as recently as 1 September, on relinquishing his position as managing director of the Yale and Towne Manufacturing Company, Willenhall, has been appointed chairman and managing director of the new subsidiary.

Engineering Prospects Viewed by BSA

In his statement accompanying the group's accounts for the twelve months ended 31 July last, Mr. Eric Turner, chairman of the BIRMINGHAM SMALL ARMS COMPANY LIMITED, refers to the organization's trading position in the current year.

He says that, in all the circumstances, it is impossible to forecast with confidence the results for 1961-62, but it seems to him that, if there is no general improvement soon in some of the fields in which the group operate, it will be difficult to maintain the figures for 1960-61. Indeed, it would be wise to anticipate some reduction, but not, he hopes, "to a serious extent."

Trading conditions in the engineering and steel industries are at present patchy and there seems to be no sign of any overall improvement in the immediate future. The machine tool companies still have full order books and satisfactory results can be expected from them. On the other hand, the order position for motor-cycles, steel and certain general engineering work is causing some concern and it seems likely that the firms engaged in these types of activity may have an indifferent year.

As to the effects of the European Common Market on the group's activities, should Britain decide to become a member, Mr. Turner says that they have naturally been studying the implications of such a step. His own broad assessment is that, while the group's prospects will not be improved in the early stages, he does not anticipate any disastrous consequences.

Everyone who has the best long-term interests of United Kingdom industry and its employees at heart must realize, Mr. Turner emphasizes, that some of the country's industries are no longer competitive in price and, consequently, that it is essential to call a halt to the policy of granting wage increases without corresponding productivity.

Discussions are already taking place between BSA and one or two leading Continental companies, especially in the machine-tool and general-engineering fields, to see whether they can enter into cross-licensing arrangements and agreements for the exchange of information.

Machine Tools Continue to do Well

Dealing with the accounts for the twelve months to the end of July last, Mr. Turner says that he and his colleagues are a little disappointed by the outcome of the year's trading. Figures for the first three or four months were encouraging, but increased production costs throughout the group resulted in a marked falling-off later on.

The depressing effects of the hire-purchase restrictions on the sale of some of the group's products also contributed to that result. Even so, some of the group's activities, notably in machine tools and steel, showed improved results. These were, however, insufficient to offset the reduction in others.

Profits of the group, before taxation, amounted to nearly £2,933,000 and were slightly less than was forecast a few months ago. They show a reduction of some £485,000 from the level for the previous twelve months (a fall of about 14 per cent), although the group's turnover for 1960-61 was somewhat in advance of that for the earlier period.

The highlight of the year was the acquisition in January of the CHURCHILL MACHINE TOOL COMPANY LIMITED and, in many ways, Mr. Turner considers that the machine tool field offers BSA their most logical avenue for expansion. Many of Churchill's activities will be strengthened by that company's inclusion in the BSA group's tool division, which is considered to constitute at the present time what is probably the second largest machine tool organization in this country.

Churchill's have a very large order book indeed and, to some extent, the long delivery dates being quoted are now affecting the rate of receipt of new orders. The firm are anxious to increase their output considerably but there they are severely handicapped in their efforts by the prevailing shortage of skilled labour.

Uses of Anti-Vibration Rubber Mountings

A range of flexible anti-vibration mountings has been developed from the original Cushyfoot, made by Metalastik. Here are uses to which four types have been put.

ANTI-VIBRATION mountings made by Metalastik with the names Cushyfoot and Cushymount are bonded rubber/metal assemblies. Cushyfoot mountings include three series. The A series provides ¼ in deflection for loads of 170 to 700 lb. The B series extends this up to 3,500 lb for the same deflection. The high deflection (HD) series provides ½ in deflection for loads of 1,125 to 2,250 lb. Even greater deflections can be obtained by doubling up the HD series or by designing special units based on the Cushyfoot principle of loading rubber in shear and compression for high deflections and high load-carrying capacity. In many applications, friction locating pads obviate the necessity of bolting machinery to the mountings or the mountings to the foundation.

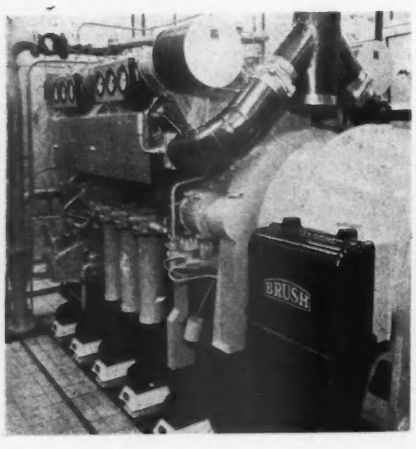
The Cushyfoot S series offers a deflection of ¼ in under a load of 2,500 lb and is intended for the lightweight, high-speed diesel engine now coming into use on locomotives. And finally, complementary to the Cushyfoot S mounting, the Cushymount is for heavy diesel engines running at slower speeds and provides deflections up to ⅜ in under loads from 1 to 5 tons.

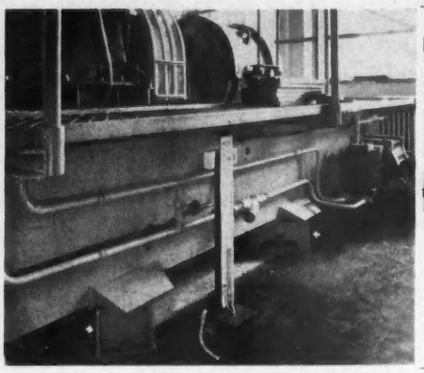
The mounting of diesel generator sets has been given special study, say Metalastik. Sets powered by over 40 makes of diesel engine have been successfully vibration-isolated by Cushyfoot mountings. On this subject, the following sections describe applications of the Cushyfoot HD1, a special version of the Cushyfoot, the Cushymount, and the Cushyfoot S mounting.

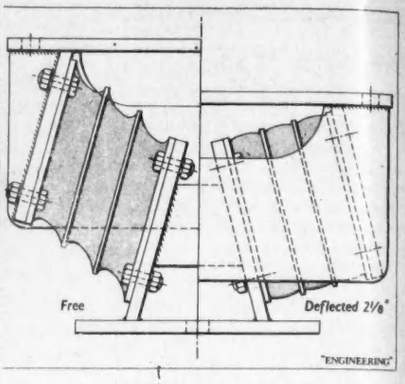
Metalastik Limited, Evington Valley Road, Leicester.

Generator Mountings in Water Pumping Installation

At the Crayford pumping station of the London Metropolitan Water Board, Cushyfoot HD1 mountings are used on the standby generator, as shown below. This installation consists of a Paxman 12-cylinder engine coupled to a 375 kVA Brush alternator weighing a total of 17,000 lb. Running at 1,500 rpm, the set is supported on a rigid steel baseplate with the 14 rubber mountings so placed that there are eight under the engine and six under the alternator. With this arrangement, Metalastik report that the static deflection is 0·28 in giving over 90 per cent vibration insulation.







Mountings for Two-Stroke Diesel

Two years ago, Metalastik were invited to design a mounting system for a two-cylinder two-stroke vertical diesel engine on a test bed at Caltex Laboratory in Holland. The final solution, which has been shown to give vibration insulation of over 85 per cent with small amplitude of vibration, is shown above.

The diesel engine was described by Metalastik as a difficult one to mount, as it ran at only 430 rpm with estimated out-of-balance couples of 40,100 lb-in primary vertically, and 51,000 lb-in primary horizontally. There was also a significant second harmonic out-of-balance torque (at 860 cpm) which at a mean indicated pressure of 100 lb per sq. in assumed a value of 21,100 lb-in and caused oscillation about the longitudinal axis.

It was decided that extra inertia would have to be given to the mounted weight which was only 12,520 lb including flywheel, coupling and alternator. To this end, the set was mounted on a reinforced concrete block weighing 51,690 lb. Special Cushyfoot assemblies were designed and eight were made up as shown here so that a static deflection of 2⅛ in was attained with a vertical stiffness of 4,200 lb per in on each. The total vertical stiffness of the suspension was thus 33,600 lb-in. With these mountings the movement of the top of the engine 117 in from the centre of gravity of the set, due to the primary vertical couple, was reported by Metalastik as being only ±0·0036 in, and other movements due to out-of-balance couples and forces were of a similar magnitude.

Metalastik say that assemblies similar to those supplied to Caltex have been fitted with great success under an ore-crushing machine.

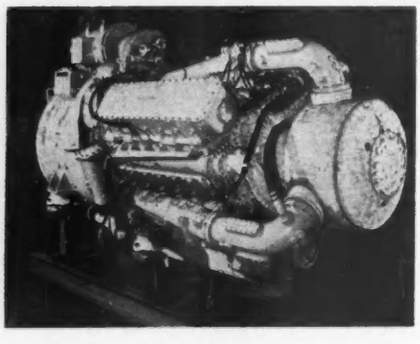
Diesels on Locomotives

In the illustration below can be seen one of the twin power plants of the 3,300 hp Deltic locomotives. Each 1,650 hp Napier engine weighs 10,598 lb and is coupled to a generator weighing 13,869 lb. There are four Cushymounts placed so that two effectively support the weight of the engine and two support the generator. To this end, mountings with slightly varying vertical stiffness are used so that the static deflection is just over ½ in on all four mountings.

These Cushymounts are used for MAN engines on diesel-electric Pullmans, on AEI locomotives for the Irish State Railways, and on locomotives for the Finnish State Railways.

The Cushymount differs from the original Cushyfoot and Cushyfoot S mountings in that it has the same stiffness in transverse and longitudinal directions. Like the Cushyfoot S, the Cushymount is designed for shock loads and movement is limited by an integral adjustable buffer.

Metalastik say that Cushyfoot S mountings are fitted to a number of 2,200 hp BB diesel-hydraulic locomotives with Maybach engines and Mekydro transmission, and to the North British 1,100 hp BB locomotives with MAN engines and Voith transmission on the Western Region.

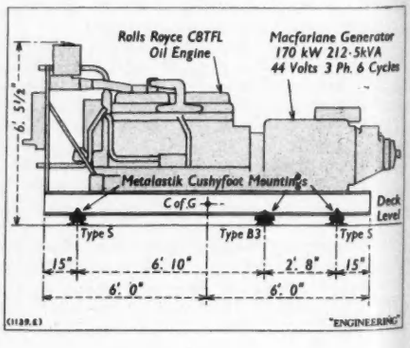


Marine Generator Mountings

When the Cushymount and Cushyfoot S mountings were designed, Metalastik say they envisaged that the integral buffering provided for locomotive applications would commend them for marine installations.

They now report that three Petbow alternators are being installed on the "Transvaal Castle" being fitted out at John Brown's on Clydebank. They will be mounted according to the lower right-hand illustration. This shows a 170 kW MacFarlane alternator coupled to a Rolls-Royce C8TFL engine. Cushyfoot S mountings are placed at each corner with two Cushyfoot B1 mountings positioned slightly off-centre for even weight distribution.

Metalastik draw attention to the fact that no anti-roll buffers are fitted. Earlier Petbow sets have been mounted on eight Cushyfoot B mountings with six separate buffers to limit movement in a seaway, but the use of Cushyfoot S mountings has enabled the number of location points to be reduced from 14 to 6.



Plastic-Coated Steel Floorplates

Consett Iron Company are now offering a rigid mild steel floorplate coated with a mixture of pvc and grains of hard material. It has been developed in conjunction with ICI using their Welvic pvc.

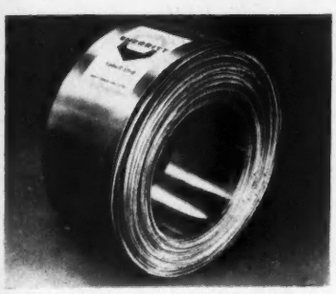
Qualities claimed for this floorplate by the makers are: enhanced resistance to corrosion; safety non-slip surface; hard wearing and easy cleaning; and suitability for use both inside and outside. This product can be supplied in sections or fabricated to any size or shape. Consett comment that a single coat of plasticized pvc can be applied to their Supergrip pattern floorplate.

Consett Iron Company Limited, Consett, County Durham.

Ductile Cobalt Strip Available from Canada

Pure cobalt coiled strip, now being offered by Sherritt Gordon Mines of Canada, is claimed by them to be the first to be made commercially available. Thicknesses of the strip range from 0·005 to 0·025 in in widths of ¼ to 6 in. Sherritt Gordon say they will supply strip in production lots at prices favouring quantity orders. The coil shown in the illustration weighs 123 lb.

Improvements in cobalt's properties which have resulted in this offer are said to result from the purity of the product. Sherritt Gordon cobalt strip is rolled directly from the company's cobalt powder using a powder rolling process which the company claim is new. Resultant purity is 99·9 per cent.



The makers say that mechanical properties can be readily adjusted by proper heat treatment. For example, cobalt strip, cold rolled to a 25 per cent reduction, has a tensile strength of 165,000 lb per sq. in, an elongation of 0·5 per cent and a Rockwell hardness (45T) of 85. In the annealed condition, this strip has a tensile strength of 115,000 lb per sq. in with an elongation of 15 per cent, and a Rockwell hardness (45T) of 68.

With this improvement in ductility, Sherritt Gordon comment that cobalt strip becomes an important design material for applications where corrosion resistance and high strength at high tempratures are essential. Cobalt is twice as strong as nickel, retains this strength to higher temperatures and has similar corrosion resistance. Magnetic properties are retained to a higher Curie point than nickel and one application which Sherritt Gordon consider to be promising is in magnetic tape for computers.

Sherritt Gordon Mines Limited, 25 King Street West, Toronto 1, Canada.

Cover Protection for Glass Fibre Insulation

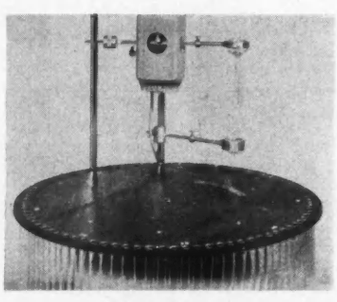
Glass fibre wadding is the most generally used insulation material in aircraft today, say Fothergill and Harvey. It is usually about 1 in thick, has excellent insulation properties and is very light in weight. However, such wadding has a high moisture uptake and extremely large quantities of water can be absorbed on larger type aircraft. In addition, rapid degradation occurs when the wadding comes into contact with hydraulic oils.

To provide a solution, Fothergill and Harvey developed a composite outer covering material which they say is to be used on the Vickers VC10. It consists of a laminate of Dow Saran film with a layer of Lantor/Tygaweb non-woven fabric which has high puncture and tear strengths. Joints on the covers in the Vickers VC10 will be high frequency welded and the makers say that this will give a bond capable of excluding moisture and hydraulic fluid. Main characteristics are: weight 2·5 oz per sq. yd (based on 100 gauge film); tensile strength, 28 lb per in; tear strength, 0·65 lb; flammability, self extinguishing; and elongation at break, 15-20 per cent.

Fothergill and Harvey Limited, Littleborough, Lancs.

Densified Wood Collector Plate

The latest models of automatic fraction collectors for chromatography made by the Central Ignition Company of London incorporate a new type of collector plate made from densified wood laminate. Permali, makers of the laminate, report that this is the first time that the material has been chosen for the purpose.



The grade used in this application is Permali BH which is impregnated with synthetic resin to combine acid resistance, strength and rigidity with a good surface appearance. Permali say that the characteristics of the material permit accurate machining to close tolerances with stability under all normal service conditions.

Permali Limited, Bristol Road, Gloucester.

Chromating Processes for Zinc and Plate

The Bonderite 250 series of chromating processes have been introduced to fulfil a need for large scale production, says Pyrene, the makers. Ease of chemical control and low chemical costs are two advantages. The 250 series are designed to operate at room temperature and to produce on hot dipped galvanized steel, electro-zinc plated steel or zinc based alloys, chromate coatings which give considerable corrosion protection. The coatings are also said to form an excellent surface for subsequent painting.

The range at present consists of three processes. Bonderite 250 is formulated to produce a colourless coating with reasonable corrosion resistance which would be useful for preventing "white rusting" of articles during storage, and in other circumstances where a coloured film is undesirable.

Bonderite 251 also produces colourless coatings, say Pyrene, but with improved corrosion resistance. When submitted to salt spray tests this process showed a considerable increase in corrosion resistance over other colourless chromate coatings.

A heavier yellow-coloured chromate film is produced with Bonderite 255 and the corrosion resistance is said to be high as is associated with coatings of this colour.

Pyrene say that the Bonderite 250 series has been extensively tested in their laboratories and is now in full scale production use. It is expected that Bonderite 250 will be delivered in bulk by road tanker to at least one large customer later this year.

Pyrene Company Limited, Metal Finishing Division, Great West Road, Brentford, Middlesex.

Lightweight Air Ducting

Two ultra-lightweight Punka-Louvre ducts have been produced by Baxter Woodhouse and Taylor of Manchester for inclusion in the passenger air-circulating system on the de Havilland Trident.

Weighing only 2¾ lb overall, the ducts are 23 ft long with an inner diameter of 3½ in tapering down to 2⅜ in. Fothergill and Harvey, suppliers of the Tyglas reinforcement used in this application, say that they are flexible and can reform to contour after crushing without any damage.

The ducting is insulated with a layer of glass wool covered with a final layer of Tyglas Y271 coated with pvc. The weight of the duct without insulation is only 1 lb 10 oz.

The ducts are said to be self supporting over their whole length, and when fitted in the aircraft are supported at only four points. Fothergill and Harvey say that in this design, brittleness which has previously been troublesome, has now been overcome.

Baxter Woodhouse and Taylor Limited, Poynton, Manchester.

Fothergill and Harvey Limited, Littleborough, Lancs.

Plastic Dough Horn for Fire Extinguisher

The Foamite carbon dioxide filled fire extinguisher now has a director horn moulded from Rockite dough moulding compound. British Resin Products, suppliers of the moulding material, comment that it is strong and able to withstand great heat without melting or buckling. Such moulded horns, they add, have passed rigorous tests and have been approved by the Fire Offices Committee, and by the Ministry of Transport for marine use.

The horns for the Foamite 2½ lb and 5 lb capacity extinguishers are moulded by Xenit Products of Slough.

British Resin Products Limited, Devonshire House, Piccadilly, London W1.

Cutting Fluids and Their Performance

During the past decade significant developments have been made in cutting fluids. These fluids are being gradually improved as more knowledge is gained of additives and as testing methods advance.

By I. S. Morton, B.Sc., A.M.I.Mech.E., A.M.I.Prod.E., and A. L. H. Perry, B.Sc.(Tech.), F.I.M.
Shell International Petroleum Company Limited

MODERN cutting fluids comprise the main classes shown in Table I, all of them being produced in various grades to suit different applications. As additives increase in variety and improve in quality, and as knowledge of their action in machining operations extends, commercial cutting fluids generally are undergoing gradual improvement. If we compare the situation today with that of about ten years ago, the changes may be summarized as follows.

TABLE I *The Different Classes of Cutting Oils*

Classifications	Sub-Classifications
Mineral and Compounded Oils	
Extreme Pressure (EP) oils	(*a*) Active (i.e. containing elemental sulphur and therefore liable to stain copper and copper alloys) (*b*) Inactive (i.e. containing little or no elemental sulphur) (*c*) Multi-purpose (i.e. performing other functions as well as being cutting oils)
Soluble oils	(*a*) Opaque emulsions (*b*) Clear or translucent emulsions (*c*) EP
Water-base fluids	

Mineral and Compounded Oils

These two types of oil have remained essentially unchanged, since there is little scope for development. Straight mineral oils remain in limited use where their lubrication power and cooling capacity are adequate. Compounded oils (i.e. the so-called mineral/lard oils) are still quite widely used, but their performance has been far surpassed by that of Extreme Pressure or EP oils, and their use is gradually dwindling.

Extreme Pressure (EP) Oils

Sulphur, still used in both the free and combined forms, continues to be the most important EP element, with chlorine, always in the combined form, the unchallenged second element. EP compounds now available, of sulphur (especially sulphurized fatty oils), of chlorine (chlorinated waxes and chlorinated paraffins), and of combinations of the two (sulpho-chlorinated fatty oils) are more consistent in quality, often paler in colour and lower in viscosity, and more effective weight for weight, than earlier products. All this has led to improvements in performance and in workshop acceptability.

It should be noted that these changes have come about in rather different ways in different countries, and such requirements as improvements in colour, absence of odour, and lower viscosity, vary widely with the country concerned. In general, there has been less urgency to turn to lighter coloured oils in the UK than in the USA and Continental Europe. On the other hand, the really dark coloured oils based on sulphurized mineral oil have almost disappeared from the UK as well as from the Continent, but can still be found in the United States. Hence, provision of acceptable cutting oils is influenced by requirements other than the strictly technical.

It will be noticed that both active EP oils (those that stain copper) and inactive EP oils (those that do not) are mentioned since, generally, both types continue to be supplied. The familiar and attractive idea of dispensing entirely with active types, and thereby simplifying application, has not so far proved realizable, the free sulphur that causes copper staining still being indispensable for the best performance in many cases. However, active grades are now produced combining cutting performance good enough for many purposes with negligible danger to yellow metals, whether as workpieces or as machine tool components, thus minimizing the need to switch cutting fluids for different work.

By use of the very highly chlorinated additives that are becoming increasingly common, it is now possible to produce grades of much improved performance for the machining of particularly tough materials such as those used for high temperature applications in gas turbine engines. Oils of this kind have largely taken over the tasks for which it was formerly necessary to make use of carbon tetrachloride which, unlike the chlorinated additives referred to above, is hazardous because of its high toxicity. Incidentally, high performance cutting oils of this type should not be used for the simpler classes of work because, apart from their high costs, they can be too active in certain instances, causing unnecessary chemical wear of the tool.

Another important newcomer to the EP class of oil is the multi-purpose cutting oil, which has become particularly well known in Germany and, to a lesser extent, in the United States. Besides being "inactive" and therefore suitable for the machining of all non-ferrous metals as well as most steels, such oils have the high viscosity index, the stability, and the anti-corrosivity required for hydraulic service, as well as the subtle anti-friction properties necessary to avoid irregular motion (stick-slip) on machine slideways. They can thus perform every lubricating function on a machine tool, without exception, as well as serving as the hydraulic oil. This can be of considerable convenience to both designer and user, especially for automatic lathes.

The improvements in additives already referred to may be expected to be followed by others—particularly in the case of sulpho-chlorinated types (combining both sulphur and chlorine in a single additive)—with consequent benefits to cutting fluids. Other EP elements may also come into prominence. For example, some limited use is being made of phosphorus compounds. Generally, however, their considerable potentiality has so far been largely unrealized in practice, because of secondary technical problems and high cost.

Soluble Oils

The conventional terms "opaque" and "clear" refer, of course, to the appearance, not of the neat oil itself, but of the dispersions in water actually used in machining. (Incidentally, the EP types, containing EP material based on sulphur or chlorine, or both, are usually opaque.)

Current first quality opaque oils have better anti-corrosivity, in general, than earlier types, this being the main point of improvement. This is true also of the clear oils, but these have not grown in popularity as much as once seemed likely. Reasons for this are their greater cost, the fact that the emulsions do not remain clear indefinitely in service, and the advent of the water-base fluids referred to later.

Notable improvements have been made in the stability and performance of EP soluble oils, which now fill a valuable role as superior, though more expensive, alternatives to conventional soluble oils for difficult work such as deep drilling, boring or form turning. In this respect they have superseded straight cutting oils in cases where the latter gave difficulty with fuming because of the high heat evolved in heavy cutting, but usually they cannot compete in operations such as threading and tapping, where the required performance can only be given by straight cutting oils. Hence EP soluble oils cannot reach the overall performance level of non-aqueous EP oils, and little is now heard of the idea, popular at one time, of their becoming universal fluids, merely diluted to different degrees to suit particular jobs.

There have been general improvements in the ease of emulsification, resistance to hard water, and stability of soluble cutting oils generally. There have also been other developments such as the growing use of alcohol coupling agents in place of the former phenolic types, since the latter involve some hazard of skin irritation when present above certain limits of concentration. Finally, there has been growing interest in the incorporation of bactericides, with the aim of not merely reducing hazards for operators, but retarding breakdown of emulsions through bacterial attack. This practice may develop as improved bactericides become available.

Water-Base Fluids

These products, which are solutions of chemicals and contain no oil, may be regarded as superior modern alternatives to the old-fashioned soda solution, at one time so common but largely superseded now by satisfactory soluble oils. Water-base fluids demand considerable ingenuity and complexity in formulation if they are to be effective cutting fluids while still remaining innocuous in ancillary aspects such as corrosivity to non-ferrous metals.

It is not yet clear how important such fluids will become, but they are already widely used, so far mainly in grinding where their freedom from oil avoids the familiar fatting-up of the wheel. As well as retaining their clarity indefinitely, they have useful EP properties.

The Testing of Cutting Oils

The development of improved cutting oils entails assessment of performance, both in relation to the actual cutting operation and as regards secondary factors such as corrosivity, foaming and stability. These secondary factors can be evaluated in the laboratory without undue difficulty and will not be discussed further here. The task of greatest interest and difficulty is the evaluation of performance in cutting.

Small scale rigs, such as the 4-ball machine, can indicate broad levels of performance, but any screening guidance they give needs confirmation and, amplification in actual machining.

Machining tests in the workshop have existed to some extent ever since cutting fluids were introduced, and reference to their use and limitations is made later. However, in develop-

TABLE II *Typical Drilling Test Results—¼ in Diameter Drill*

Oil Number	Number of Holes drilled before failure	Average Number Holes
1	148, 140 124, 126	135
2	136, 126 98, 102	116
3	90, 87 46, 82	79
4	62, 52 53 72	68

Drills used: ¼ in diameter HSS manufactured and ground to test limits.
Material drilled: BS 328 steel (0·6 per cent carbon, 0·65 per cent manganese).
Speed: 845 rpm, 138 fpm.
Feed: 0·014 in per rev, 11·8 in per min.
Depth of hole: 1½ in.

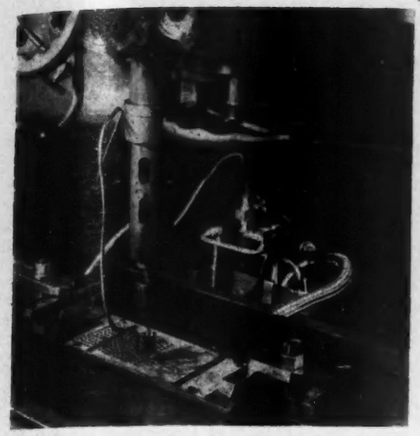


Fig. 1 Small-scale drilling test.

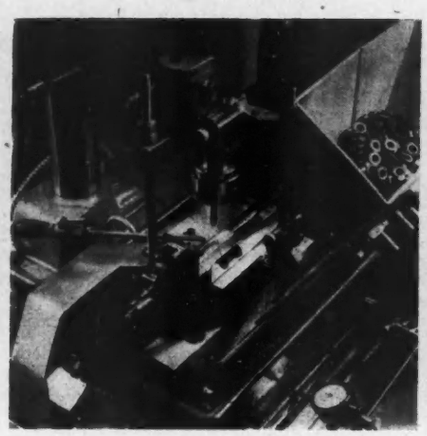


Fig. 2 Small-scale tapping test.

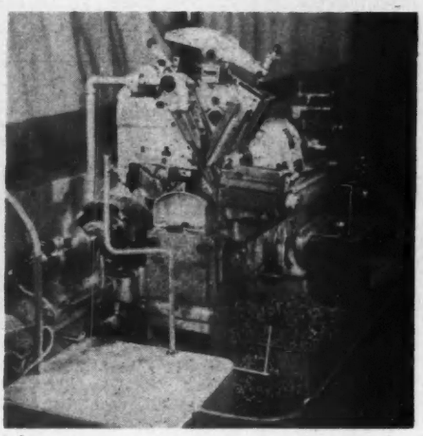


Fig. 3 Automatic lathe during cutting oil tests.

ment work it is found necessary to carry out machining tests under laboratory conditions with strict control over tool material and shape, work material and condition, and all the many other factors that can influence a machining operation.

Drilling tests have been well established for a decade or so, typical results being given in Table II. It will be observed that there was a considerable amount of scatter in the individual results, despite the precautions observed, and though it was possible to place the four oils concerned in two groups, namely 1 and 2, and 3 and 4, it was not possible to discriminate within groups.

These particular results were obtained with drills of fairly substantial proportions, and the variations inherent in machining operations become even greater as the scale decreases. This is illustrated by Table III, which refers to

TABLE III *Typical Small-Scale Drilling Test Results—¼ in Diameter Drills*

Oil Number	Number of Holes Drilled before failure	Average Number of Holes (Geometric Mean)
11	367, 467, 679, 466, 847, 613, 878, 308	540
12	157, 345, 257, 212, 323, 276, 211, 370	259
13	230, 204, 171, 186, 250, 322, 220, 448	242
14	508, 258, 323, 504, 362, 420, 424, 471	399

Drills used: ¼ in diameter HSS selected and ground to test limits.
Material drilled: BS 328 steel (0·6 per cent carbon, 0·65 per cent manganese).
Speed: 1,500 rpm, 98 fpm.
Feed: 0·010 in per rev, 15 in per min.
Depth of hole: 0·42 in.

drilling tests carried out for reasons of economy with ¼ in diameter drills, but using a greater number of tests per oil. The greater scatter is quite apparent, and again the information obtained could only be relied upon for the broader discriminations. Fig. 1 shows the drilling rig set up for these tests.

For full evaluation of an oil it is necessary to carry out machining tests by other operations in addition to drilling, and tapping tests are useful for this purpose. Here again, where the scale of operation is large, reasonable precision is obtainable, but is diminished when operations are carried out on a small scale. Nevertheless, such tests, a set-up for which is illustrated in Fig. 2, can be very useful. Thus the results given in Table IV, although unable to discriminate between oils 22 and 23 (which were later shown by other tests to have a rather different level of performance), clearly showed the four oils under consideration to be of three distinct performance levels. Turning tests are also useful, and Fig. 3 shows a Bechler single-spindle automatic lathe set up in a laboratory to rate cutting fluids in a parting-off operation.

TABLE IV *Typical Small-Scale Tapping Test Results—¼ in BSF Taps*

Oil Number	Number of Nut Blanks Tapped before rejection	Average Number Tapped (Geometric Mean)
21	100, 50, 50	63
22	50, 150, 580, 800, 900, 650	356
23	700, 190, 500, 250, 375, 300	351
24	>1,500, >1,500, >1,500	>1,500

Taps used: Selected HSS ground thread taps, ¼ in BSF.
Material tapped: ¼ in mild steel nut blanks.
Speed: 1,000 rpm.

Despite their limited applications, tests of these kinds are of great value. Apart from discriminating between various additives and additive combinations, they are also useful as a guide to the amounts of additive necessary for particular classes of operation. The curve in Fig. 4 shows the results of drilling tests carried out to determine the influence of a sulphurized fat in a mineral oil. Although this curve is, of course, valid only for the particular additive and machining conditions, it illustrates an important general feature of cutting oil performance, namely, that there tends to be an upper limit to the effective amount of additive.

So far, cutting oil performance has been mainly referred to in terms of tool life. It should therefore be pointed out that tool life can be interpreted or specified in various ways, and these must be borne in mind when arranging tests and studying their results. Apart from specifying tool life in terms of complete breakdown (as in Tables II and III), it may also be specified in terms of the maintenance of the desired dimensional or surface finish limit (Table IV). These differing requirements may not be compatible; for example, it is frequently impossible

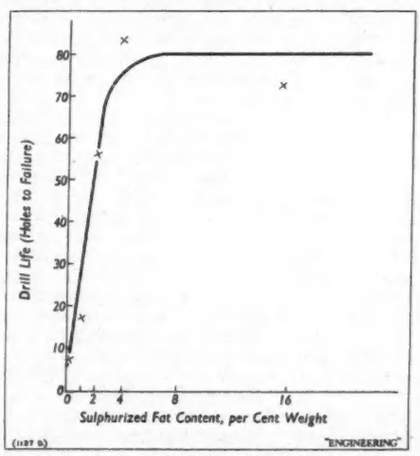


Fig. 4 Influence of sulphurized fat on cutting oil performance.

to devise one cutting fluid that will give both the maximum possible tool life and the best possible surface finish for a particular operation.

Workshop Trials

Turning now to workshop trials, these have long been used for assessing cutting oils. Under the conditions usually prevailing, however, the results are all too often unreliable and must be studied with great caution. This is hardly surprising in view of the many variables involved, and it is unreasonable to expect close control over all of these under the usual workshop conditions. To obtain reliable results in the workshop, therefore, it is necessary to do one of two things—either to find the rather rare workshop where circumstances dictate close control over the factors involved, or for the experimenter to exercise the necessary supervision and provide the recording facilities in the workshop of co-operative customers.

An admirable example of the former alternative has been provided by a factory which manufactures drum closures under exceptionally close material and tool control. A six-spindle tapping machine is used solely for tapping 2 in BSF threads in a standard component, and the total number of flanges tapped by a set of six chasers (which may range from 10,000 to 70,000) before the threads are rejected by the inspection department, has proved an invaluable means of rating and developing cutting oils.

In the other type of test, a great deal of care has to be taken but tact and persistence can produce valuable co-operation. A necessary preparation for any series of tests is to spend some time in the workshop observing operating

TABLE V *Data from Controlled Field Trial on Automatic Lathe*

Oil Number	Mean Tool Life between Regrinds, hours			
	Forming	Drilling	Recessing	Parting-off
41	7·2	18·1	15·3	9·2
42	8·1	8·3	8·5	7·4
43	8·2	11·5	13·2	8·2
44	10·0	21·0	19·2	11·0
45	8·2	13·5	13·2	8·5
46	8·3	10·5	12·1	9·2

conditions, methods of recording, interpretations of loose terms such as "tool wear", and what criteria are unquestioningly accepted, before initiating any tests whatsoever.

If such tests are to be carried out at all, expenditure of much time and effort must be accepted. Thus, the tests recorded in Table V were from an apparently simple comparison of six oils on one single-spindle automatic machine, set up for one sequence of operations on a nut blank. Although only four tool stations were involved, it was found that approximately 230 hours had to be run per oil, necessitating the recording of from ten to thirty tool changes per station on each oil.

On the Shelf

By Frank H. Smith

It seems a long while ago that I mentioned the first of the lists, issued by the editor of the Oxford English Dictionary Supplement, giving words for which they hoped to get earlier references than those quoted. Now, with the 13th such list, they have reached " zwitterionic " and there is a gracious note of thanks to those who have helped. I have met some of those helpers, and a nice tedious task some of them have, wading through years of " standard " periodicals, reading through typical period books and so on. God bless 'em for their efforts to keep our language documented and authorized. I suppose the work goes on—in fact I *know* it does. But I know one historian who has coined a perfectly *ghastly* technical word and I hope that it is thrown out neck and crop for some reason or another.

A horrible indication of the amount of chatter that goes on around us is shown in Iliffe's (Dorset House, Stamford Street, London SE1) *Guide to Broadcasting Stations*, now in its 13th edition. On short wave alone, they tell me, there are over 2,000. And over 1,600 telestations and 1,300 vhf transmitters. It's a wonder somebody hasn't decided that this lot affects the milk. Moscow, by the way, has over 160 short-wave transmitters. (For those who like figures.)

B.S.I. have put out a leaflet with a little man on it bashing the guts out of a suitcase. This illustrates their first sample question (how durable should a suitcase be?) of a list showing the sort of thing dealt with by their Consumer Advisory Council's *Shopper's Guide* at 15*s* a year from Orchard House, Orchard Street, London W1.

Quotation coming up. " *Market Research* is the only report of its kind in the world. A new... a vital tool for those who make decisions." It's published by E.R.C. (Market Research) Ltd., 17-18 Dover Street, London W1, at 12 guineas a year. But for the leaflet I have to thank Universal Subscription Service, 25 Sudeley Street, Islington, London N1, who invite your inquiries. Their speciality is working things out so that you pay all your subs at one time. This may be a boon if you have enough money to cover them all at once!

Islington Public Libraries do a neat little leaflet with four photographs on the front that look like the front page of the *Eagle*. The leaflet lists books on *The Way to the Stars*, and of course the four mug-shots are of Gagarin, Shepard, Grissom and Titov. The books listed are astronautics and astronomy.

Have I mentioned before the remarkable series of *vade meca* published by the American Society for Testing and Materials (that " and " is new), under the general heading Special Technical Publications (STP)? No appropriate shelf should be without them. The latest are *STP 284, Symposium on Acoustical Fatigue* at $2 50; *287, Symposium on Low-Temperature Properties of High-Strength Aircraft and Missile Materials* at $7; *289, Symposium on Shear and Torsion Testing*, at $4.75; and *296, Report on Physical Properties of Metals and Alloys from Cryogenic to Elevated Temperatures* at $4.75. If these temperatures sound a bit vague they are − 475° F to 4500° F according to the blurb. The address is 1916 Race Street, Philadelphia 3, Pa., USA.

Not so long ago it was fun to make a bloomer in this column because in the post on Monday morning would be a postcard from Geoffrey Parr with a correction plus a piece of erudition that would send me off to the quotations dictionary or a Fowler or some other reference item. Geoffrey, alas, died a few months ago and his place as chief editor for scientific and technical books with Chapman and Hall has been taken by Mr. B. N. Hughes, formerly Editor of *Technology*. I am sure Charles Dickens would approve of his publishers taking into their fold somebody from Printing House Square.

Air Down the Mine

Mine Ventilation and Air Conditioning. By Howard L. Hartman. *Ronald Press Company, 15 East 26th Street, New York 10.* ($12)

Over the past few decades there has been a tremendous increase in the scale of operations in the major mining fields throughout the world, and with this increased production of minerals has come the need to be able to work at greater depths. Many mines are now working at a depth of 10,000 ft below the surface and the expense involved in maintaining adequate ventilation for miners working under such conditions accounts for a significant proportion of total running costs. No longer can mine ventilation be considered solely an art rather than a science, although Professor Hartman's latest book does achieve a successful marriage of the practical and the theoretical aspects of the subject.

Professor Hartman is head of the Department of Mining at Pennsylvania State University and has drawn upon his considerable experience as a practising mining engineer and as a teacher in producing this excellent treatise. The subject is treated in terms of the theory and practice of mine ventilation in the three main divisions of the subject—quality control, quantity control and temperature-humidity control.

After briefly dealing with the basic physics of gases the theory is developed to cover air measurements and air flow circuits ranging from simple networks capable of solution by elementary ventilation theory up to complicated networks and their solution by higher mathematics and analogues. In view of the increasing use of analogue computers in the solution of complex ventilation networks perhaps more attention could usefully have been devoted to this topic. It could of course be argued that analogues are not peculiar to mining and the subject is fully treated in standard works in other engineering fields. However, in an advanced text book such as *Mine Ventilation and Air Conditioning* the passing reference to analogue computers is at variance with the exhaustive treatment given to other, possibly less important, aspects of ventilation, particularly when considering that very few practising mining engineers are fully aware of the potential value of computers.

Throughout the book considerable emphasis is given to the part economics plays in the design and operation of mine circuits and ventilation equipment. Many working installations are exemplified and the various equipment used is described together with reasoned arguments as to why such plant was initially chosen. Within this context considerable attention is given to the design of mechanical ventilators and the significance of fan and mine characteristics.

The section dealing with temperature-humidity control is of particular interest in view of the recent emphasis on securing better environmental conditions in hot and deep mines. Although no attempt is made to develop rigorously the complete refrigeration theory, sufficient treatment is given to provide the basic understanding of the subject necessary when solving mine air refrigeration problems.

Professor Hartman has also usefully included a chapter on mine dusts, containing some very interesting statistics regarding the harmfulness of exposure to mine atmospheres containing excessive amounts of dust. The measures taken to combat excessive air-borne dusts are detailed and also standard practice relating to the measurement of dust concentrations. Although the author has concentrated upon American practice throughout the book, the work is not at all parochial in its treatment and indeed the very comprehensive bibliography at the end of the fifteen chapters reveals that the author has ranged wide to gather material for this first class work. The book is extremely well produced with excellent diagrams and a clear and understandable text. It will prove of value to the practising mining engineer and to the student preparing for the examinations conducted by the various professional institutions and mining colleges.

A. Grierson

A Study in Planning

The Steel Industry, 1939-1959. By Duncan Burn. *Cambridge University Press.* (80*s*)

Since national planning has come to the fore, the steel industry has been held up as a successful example of the British genius for compromise: individual private firms, supervised in the national interest by a Board responsible to a Minister. What, in fact, have been the results?

Broadly, the Board has controlled (*a*) the prices of the raw materials—imported ores and scrap—and (*b*) the profit margins of heavy steel and billets. Individual firms submit major expansion plans for approval. The Board can reject proposals or insist on a different site, and it draws up five year plans for the expansion of the industry as a whole.

The theory behind the Board's controls denies that price competition compels firms to strive for efficiency and low costs, and eliminates the unsuccessful. It asserts that in slumps, firms with lower prices cannot secure much more business because demand is falling, and in booms, prices rise to a point which enables obsolescent plants to pay and to accumulate reserves to survive lean periods. It claims that prices fixed on the average costs of the efficient induce the less efficient to lower costs and thus raise profits (within the authorized price). Provided prices are not raised when demand is keen, nor lowered when it falls, pressure towards efficiency is continuous. The Board has kept scrap prices low and charged a levy on the users of cheap home ores and scrap to subsidize importers of ores. The object of the price controls is to counteract " currently abnormal" cost factors, which are said to hit steelmakers unfairly, regardless of their efficiency. The theory disregards the industry's short term costs " in order to allow steelmakers to plan on a proper assessment of real costs, and users to gauge the future prospects of the steel market accurately."

How this seductively simple theory has worked is analysed in detail in Mr. Duncan Burn's magisterial survey, which gains in authority from his exhaustive knowledge of the US and European steel industries. Mr. Burn's 700 pages, with their 105 statistical tables, and maps covering the world's steel producing centres, amounts to a steel encyclopaedia, which should be compulsory reading for all concerned with steel, or with planning whether of steel or other industries.

Mr. Burn avoids polemics by rigidly applying the economist's professional yardstick to all proposals: Will this lead to the production of cheaper and better steel, of the right types, in saleable quantities? Will it multiply or decrease national wealth? From his fully documented study, it emerges clearly that, in the battle for and against steel nationalization, neither Conservatives nor Socialists bothered with these basic questions. Both parties debated steel problems in terms of creating employment and relieving distressed areas. Both were obsessed with the need to expand production, apparently for its own sake, regardless of costs, the realities of which had been masked by wartime needs, and which were lost to sight as the controls were continued, and grew in complexity, in the wholly different circumstances of peace.

The story of Richard, Thomas and Baldwins, who wanted to put up a plant at Newport, typifies British steel planning. Newport's advan-

tages over existing sites are that ore imports can reach it in much larger ships; it avoids expensive inland transport; it is nearer to cheap home ores, is well sited for the sale of its products to domestic users, and is a good export harbour.

These, however, are purely economic factors and, as long as planners are responsible to a Ministry, the "national interest" must also include social considerations. This inevitably turns essentially economic problems into political controversies. So pressure groups launched campaigns in Parliament and Press in favour of rival sites in Wales and Scotland. The Cabinet itself was divided by Ministers alerted by their local interests. The Scottish site could import Swedish ores, but lacked cheap home ores. Scottish coal reserves were small and coal dearer than elsewhere. The site was remote from major domestic steel users. Scotland's partisans had a simple solution: import coal from South Wales. Eventually the Government disclosed the "national interest." Two mills would be set up, one in Wales, one in Scotland. Mr. Macmillan likened this to the judgement of Solomon. No one pointed out that Solomon decided knowing that if his judgement were carried out the baby would die. So we are to have two half-mills of uneconomic size and location. Ignoring the double capital investment, the division of work between two plants will result in operating costs five to ten per cent above those of low cost sites, and will limit the scope for reducing costs and raising qualities by long runs. The greatest economic advantage was sacrificed to avoid "social dislocation."

Such uneconomic planning fits no industrial strategy. The Government were soon trying to persuade motor manufacturers not to expand in their natural low cost areas but to go to Scotland to create a market for steel. British attitudes differ conspicuously from those of our strongest European competitors, whose exports have soared above ours: the European Coal and Steel Community's policies assume that *cost reduction is all important*. Our policy minimizes productivity, that of the ECSC maximizes it.

Because the planners put increased production before economic locations and costs, most expansion merely added piecemeal to existing plants instead of radically reconstructing them or building modern plants. By 1958, our European competitors were forcibly demonstrating what a producer for profit regards as elementary, i.e., that *quality* of investment as well as quantity, is vital. Europe's new oxygen steel processes, for example, save not only labour and fuel but capital. Our planners conceded that cheaper foreign producers might "in the remote future" (*sic*) increase their share of postwar world steel markets, which they assumed would never cease to expand, but they declared confidently that UK production could be switched to exports when home demand was satisfied and switched back again when home demand rose. They assumed that foreign buyers would accept such Stop and Go deliveries without a murmur. The policy of countering "current abnormal" factors by price and site controls masked the realities of world prices, demand, and supply, and encouraged wasteful investment.

Admitting that all this is uneconomic, is it defensible as planning to avoid "social dislocation"? If the process of discouraging competitive low cost industries and stimulating high cost expansion continues long enough, surely the result must be declining UK exports, accompanied by declining standards of living, the end of which would not be social dislocation but social upheaval. Nothing emerges more clearly from Mr. Burn's scholarly analysis than that what is economically profitable is also socially desirable.

JOSSLEYN HENNESSY

South African Mining

South African Mining and Engineering Year Book, 1960-61. *South African Mining Journal Syndicate, Johannesburg; Argus South African Newspapers, 85 Fleet Street, London EC4.* (89*s*)

Since this edition of the South African Mining and Engineering Year Book was published, South Africa has left the Commonwealth. The parting, more in sorrow than in anger, was accompanied by confident predictions, especially on the South African side, that it would be "business as usual." The financial, commercial and industrial links which have long bound South Africa to this country were expected to survive the political break. It is true that the republican status of the Union has not been welcomed in commercial quarters in either country and that confidence in South Africa's future has been somewhat modified on this side yet there has been no drastic reappraisal.

The mining industry in South Africa—as distinct from the engineering industry—is never likely in the future to be as important as in the past for the British engineering export industry, yet it remains important nonetheless. Gold is, of course, the main mineral and much enterprise has gone into increasing the efficiency of mining operations and in attracting native labour into the newer areas of the Orange Free State. But South Africa's gold will not last for ever and costs continue to rise while the world price of gold does not.

Efforts of the new republic to increase investment in industry must mean that a growing interest must be taken in the South African engineering industry by its existing and potential customers in this country.

The volume incorporates the Rhodesian Mining Year Book and here again the British engineering industry has a large stake. Here too there are political overtones which have for the present cast a shadow on the attractiveness of the Rhodesias for investment purposes, though less so on their market potentialities for goods. The copper mines of Northern Rhodesia have a big part to play in the further opening of their territory.

Altogether the need for the usual services for British industry in these areas, including year books and their compilation of annual statistics, is going to continue as in the past. This particular publication contains a good deal of useful information about the African market below the Equator. Possible improvements in its presentation would be to cut further the extracts from chairmen's speeches, to expand the section on the Rhodesias and to simplify and clarify the headings of the different sections.

G. E. TEWSON

Blasting Vibrations

Vibrations from Blasting Rock. By L. DON LEET. *Harvard University Press, Cambridge, Mass.; Oxford University Press, London.* (27*s* 6*d*)

The author is Professor of Geology at Harvard University, and Seismologist-in-Charge of Harvard seismological station. Within the space of 134 pages he gives the reader seven chapters on rocks and the effects produced by the detonation of explosives in them. His approach to the problems of rock breakage appears at first sight to be logical and systematic for, having outlined the factors involved in blasting, the reader is in turn presented with concise stories on explosives and on rocks before being set down to a heavier diet of rupture of rock, the elastic wave pattern and the safe limits for structures. To end with, there is a chapter headed "Observations and Applications." With the increasing use of conventional explosives in civil engineering, this book would be expected to receive a welcome from practical users of explosives but, if only because of its brevity, the book is disappointing.

On the dust cover it is described as a "thoroughly practical book" but it is doubtful whether a quarry manager or a civil engineering contractor would find that the book gives him any practical assistance, either in planning efficient blasting operations, or in avoiding complaints from the owners of neighbouring property. While it may foster in some readers a reverence for academic terminology, it will not enable the practical man to dispense with the occasional need for the services of a consultant in explosives technology.

Throughout the second chapter, "Explosives and Blasting Caps," chemical formulae of explosive compounds are presented needlessly and once set down they are used no further. A particularly unbalanced picture is sketched of "blasting caps," which British readers will know better as detonators, since the author refers only to the products of one particular company. In the matter of delay intervals for instance, the reader may get the mistaken impression that the characteristics listed in two tables apply to the products of other manufacturers as well. The two diagrams of sectioned detonators suffer from this lack of generalization, and in the delay example it is confusing to see the quite distinct ignition charge, delay composition and priming charge all identically shaded and apparently continuous. It would be interesting to know why only lead azide is mentioned as a detonator priming charge, since the manufacturer whose products are so effectively advertised does not use it in any of his detonators.

The fundamental differences between igneous and sedimentary rocks are described in a fairly satisfactory manner, but the equally important division of the metamorphic rocks does not receive adequate treatment. An engineer responsible for driving a hydro-electric tunnel in the Scottish Highlands would derive no advice from his reading of this book, but be merely frustrated to read that the cleavage of the ubiquitous schists "often exercises a profound effect on the way such rocks respond to the force of an explosive used to break them."

The treatment of rock classification is out of balance and certainly a diagram of the Reaction Series of N. L. Bowen has no place in a book of this sort, particularly when igneous rock-forming minerals are dismissed within a few paragraphs.

Disappointing too is the section dealing with jointing in rocks. Though the author says of joints that "they are universal, and the most important features that govern the response of rock to explosives" he leaves it at that, and the differences in origin and occurrence of joint systems in the three classes of rocks are most inadequately covered.

The chapter on the elastic-wave pattern describes concisely the six types of waves that may be propagated from centres of explosive disturbance, but once the reader has assimilated this academic knowledge he will find that it is of little further use to him, certainly it does not seem to be applied in the practical discussions later in the book. Though much is made of wave types and wave propagation, no attempt

is made to link this knowledge with joint patterns in rocks, with fragmentation or with the choice of the optimum delay interval. The latter in particular is left shrouded in mystery. The chapter ends with a description of the portable seismograph invented by the author.

Though the book is far too short to do justice to the subject matter, prodigal use is made of large illustrations and text figures and of widely spaced tables. It is not easy to understand why, in a book of this length, it should have been thought necessary to set aside two whole pages to photomicrographs of granite and porphyry, incidentally the only rocks so illustrated. Neither should it have been difficult to compress the twelve diagrammatic sections of crater shots into less than six pages.

It is a pity that the sequence of illustrations which have been chosen to show the progress of a large blast in a basalt quarry was taken at a site where the entire face was shrouded in deep shadow. As a result nothing can be seen of the details of the unbroken face and its mode of fragmentation, and the entire series of pictures is of little real interest. Their value is further lessened since we are denied any information about the hole spacing, loading, firing sequence and delay interval of the blast, or even of the time interval between the individual photographs. The only item not left in doubt is the name of the firm responsible for photographing the sequence for this is repeated below each of the seven illustrations.

To the serious reader who seeks to widen his acquaintance with the subject, the author has given a large number of literature references as footnotes in the text.

E. M. PATTERSON

To Better Springs

Spring Design. By W. R. BERRY. *Emmott and Company.* (40*s*)

Having been actively associated with the spring trade for 30 years, I was most interested to learn that Dr. W. R. Berry had written a book on spring design. In the early years it was very difficult for a designer to find information which would assist him and therefore a lot of experimental work was involved before one could be reasonably sure that a particular design would function satisfactorily.

Dr. Berry has had a vast amount of experience in the field of spring design and application, and has from time to time written articles for the Technical Press which have been very interesting and useful.

In this present work he has presented a most helpful book covering a very wide range of springs giving design formulae very clearly defined. In addition he discusses very many practical considerations which help the designer to appreciate what to aim for and what to avoid.

Materials are discussed at some length and the section provides the reader with information which will, no doubt, prove to be an assistance to the appreciation of the importance of choosing the most suitable material for a particular set of conditions. I would have welcomed more reference to British Standard Specifications rather than the services specifications quoted.

The Materials Sub-Committee of the Coil Spring Federation Research Organization have done a tremendous amount of work in rationalizing spring material specifications and many of them are published by the British Standards Institution.*

BS 1726, "Method of Specifying Helical Compression Springs," is under revision and the sub-committee have tabled the revised draft for consideration by the Committee of the British Standards Institution. Dr. Berry does quote this specification but certain of the tolerances he gives may soon be out of date.

Of course, any author is faced with this sort of problem and he therefore gives the latest information available at the time of writing, but I would like to point out that the tempo of spring research is increasing and the reader should be aware of this.

Whilst the reports issued by the Coil Spring Federation Research Organization are primarily intended for the members in the trade the research committee do release many of the reports for open publication in the Technical Press and therefore designers should keep a constant lookout for such articles which will be, no doubt, of great assistance to them.

Reverting now to Dr. Berry's book. I like the style of presentation. Not only are design formulae given but examples of design with discussion of the practical implications citing actual experiences which the author has had. This, to my mind is invaluable. It makes for most interesting reading without being too academic.

The area covered by Dr. Berry is very wide indeed and it is quite obvious that such a book of over 300 pages could not have been written by anyone who had not had a vast experience in the subject. References are freely used so that the reader can, if he so desires, delve deeper into the particular point which concerns him.

Summing up, I feel that this book will find its way to many bookshelves in design offices and will prove to be of great assistance to designers who wish to learn more about what for a long time was the "forgotten baby" of engineering—that oddly shaped bit of metal called a "spring."

Dr. Berry is to be congratulated in producing such a valuable contribution to our knowledge in this field.

JOHN A. ROBERTS

* BS 1408, "Hard Drawn Steel Wire for Springs for General Engineering Purposes." BS 24, "Helical and Volute Springs and Spring Steels." BS 2056, "Rust, Acid and Heat-resisting Steel Wire for Springs." BS 2803, "Oil-Hardened and Tempered Steel Wire for Springs" (oil tempered or pre-tempered wire). BS 1429, "Annealed Steel Wire for Oil-Hardened and Tempered Springs." BS 2786, "Round Hard-Drawn Brass Wire for Springs."

Trade Publications

Copies of any of the following trade publications are obtainable from the addresses given, though distribution is sometimes restricted.

Materials and Components

Plywood. FINNISH PLYWOOD DEVELOPMENT ASSOCIATION, 38 King William Street, London EC4. A leaflet listing the advantages and some recommended applications of MR-glued Finnish birch plywood. Illustrated.

Sealing Compound. TRETOL-SERVICISED LTD., 2 Caxton Street, London SW1. A folder describing uses and application of Vertiseal polysulphide-based sealing compound for critical jointing. Illustrated.

Belting. TURNER BROTHERS ASBESTOS CO. LTD., Rochdale, Lancs. A catalogue of flat transmission belting. Information is included on the use of various types of belts, use of belt fasteners, drive design, operation of belts, power capacity, recommended pulley diameters, and other aspects of belt selection and use. 20 pp, illustrated.

Plant and Equipment

Pumps. JAMES BERESFORD AND SON LTD., Ace Works, Kitts Green, Birmingham 33. A catalogue giving comprehensive details of the makers' range of surface pumps, for industrial, agricultural, and domestic uses. 14 pp., illustrated.

Machine Mountings. CEMENTATION (MUFFELITE) LTD., Hersham, Walton-on-Thames, Surrey. A booklet on Barrymount isolating machine mounts which also deals with the phenomena associated with vibration. A section is devoted to machine siting and levelling; it is claimed that these pads avoid disturbing the floor area and by means of a built-in device allow levelling to be effected in a few minutes. 13 pp, illustrated.

New Books

A History of Invention. By EGON LARSEN. *Phoenix House.* (21*s*)

A potted history of technology, presented in three main sections (Energy, Transport and Communications) and covering all the important developments from the Stone Age to the present day. There are nearly 200 illustrations—68 of which are photographs.

Theory of Elasticity. By V. V. NOVOZHILOV. *Pergamon Press.* (80*s*)

Commencing with an examination of the geometrical properties of the deformation of a solid body, the author proceeds to develop a general theory of elasticity, which—under certain conditions—can be modified to the classical (linear) theory. The application of the present theory to the solution of specific problems, such as stress concentration, torsion, bending and shear, is illustrated. Translated from the 1st Russian edition (1958).

Source Book of the New Plastics. Volume 2. Edited by HERBERT R. SIMONDS. *Reinhold, New York; Chapman and Hall, London.* (72*s*)

Based on information submitted by 69 plastics producing companies in the USA and by 4 leading plastics journals, this volume covers new materials, processes and applications introduced by and in the US plastics industry during 1959-60.

Plastics Tooling. By MALCOLM W. RILEY. 2nd Edition. *Reinhold, New York; Chapman and Hall, London.* (60*s*)

This well-established guide to the properties and fabrication of plastics as they apply to tooling has been completely revised. Many of the materials described in the present edition are either new (e.g. metal fibre reinforced epoxies) or still in the development stage. The range of application of each technique discussed is clearly stated, and there is much information on materials which would appear to have promising futures.

The Reviewers

Mr. A. Grierson, B.Sc., is a lecturer in mining at the Royal School of Mines. He is a Member of the Institutions of Mining Engineers and of Mining and Metallurgy.

Mr. Jossleyn Hennessy, M.A., is an economist and London Editor of the *Eastern Economist*, of New Delhi. He was formerly director of public relations to the Government of India and is author of several books.

Mr. G. E. Tewson, M.A., is a partner in the firm of O. W. Roskill, Industrial Consultants.

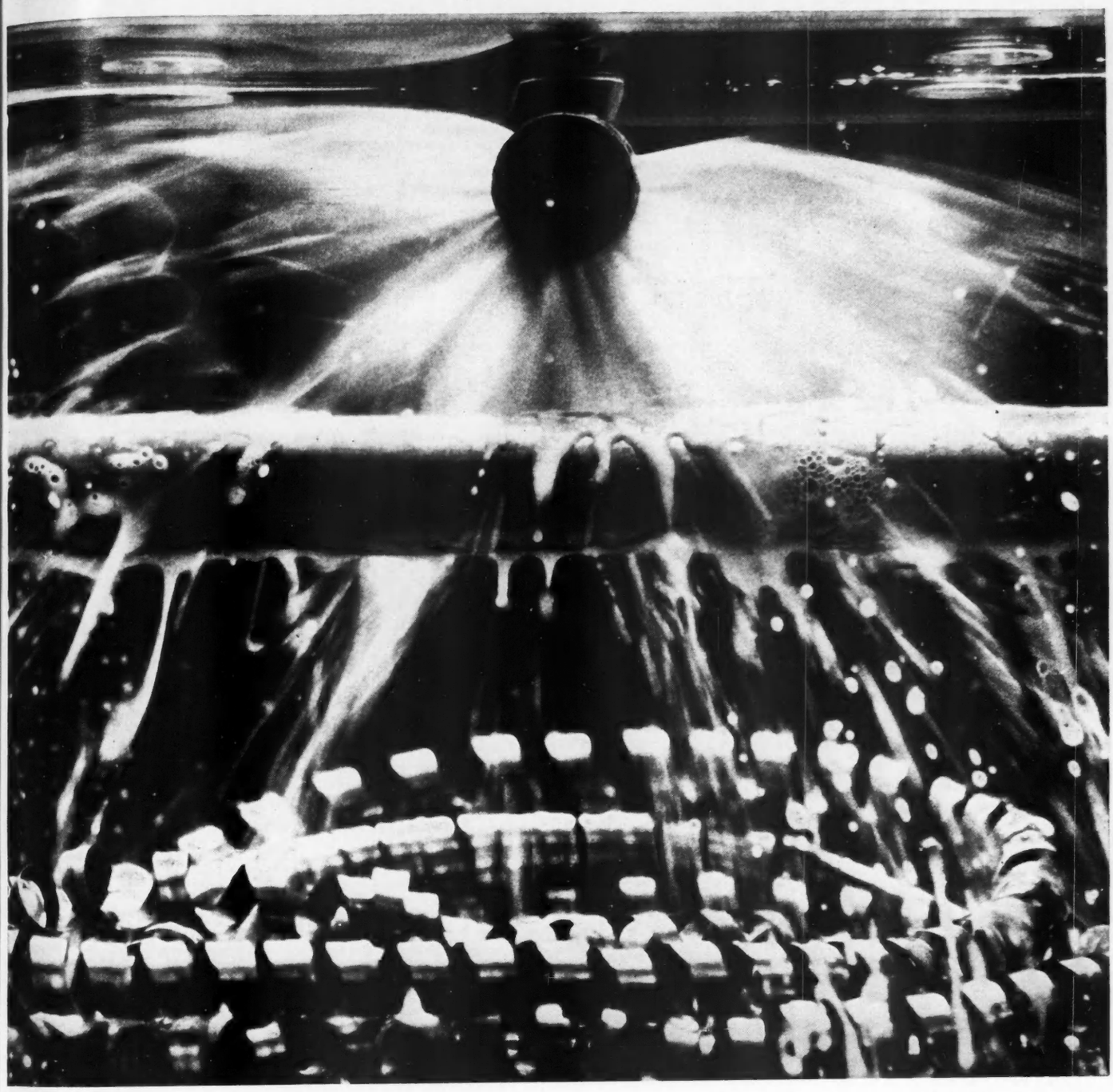
Dr. E. M. Patterson, M.Sc., is a technical officer in the Detonator Section of the Research and Development Department of Imperial Chemical Industries Ltd., (Nobel Division). His institution memberships include F.R.S.E., M.R.I.A., and A.I.Q. Of recent years he has been making a study of delay blasting.

Mr. J. A. Roberts, M.Inst.B.E., is engineer in charge of the research laboratory at Herbert Terry and Sons Limited. He is also deputy chairman of the research committee of the Spring Manufacturers' Research Association.

Steel Frame Design Examples. By IAN ROBB. *Cleaver-Hume Press.* (30*s*)

Writing for intermediate students and assuming a basic knowledge of the strength of materials and of steel design, the author deals with the subject from a purely practical standpoint. The examples, which abound, have been prepared in accordance with the provisions of BS 449:1959.

Shell demonstration



The stability and anti-rusting properties of soluble cutting oils vitally affect the sustained performance of a machine tool.

Shell Research has painstakingly studied these qualities by the comparative evaluation of different emulsifying and coupling agents. This Shell-devised rig, the Shell Emulsion Stability Test, simulates under strict control, but more severely than usual industrial applications, the conditions in which soluble oils operate.

A gallon of the emulsion is circulated continuously for 48 hours through a copper feed-pipe and over a heated iron tube before percolating back to the sump through a layer of steel turnings. Water evaporation is made up at prescribed intervals and at the end of the test.

The appearance of the oil and the condition of the feed-pipe, iron tube and turnings reveal the extent of the corrosion.

By comparing the percentage change of oil content in the slurry before and after the test, the stability of the emulsion can be expressed quantitatively.

Write for the booklet, Selecting Your Cutting Oils, to Lubricants Dept., Shell-Mex House, London, W.C.2.

SHELL

SHELL CUTTING OILS

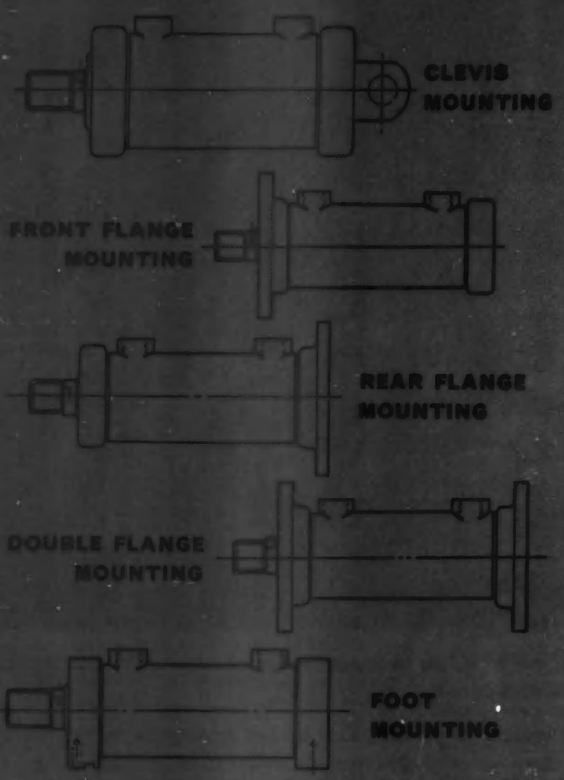
G 3

KEELAVITE
Hydraulics

DOUBLE ACTING HYDRAULIC CYLINDERS

Precision built for accurate control.
Cylinder Barrel of high quality honed steel.
Precision ground, hard chromed rods.
High quality synthetic rubber seals of advanced design.
Hydraulic cushioning available.
Designed for 'building in' to hard working industrial systems.

STANDARD MOUNTINGS



Special mounting made to customers' specifications

BORE DIA.	1"	1½"	2"	2"	2¾"	2¾"	3¼"	4"	4"	5"	6"	7½"
Type	3060 and A, B, C, or D.	3544 and A, B, C, or D/80	1957 and A, B, C, or D/80	1957 and A, B, C, or D/123	1851 and A, B, C, or D/220	1851 and A, B, C, or D/227	4295 and A, B, C, or D/80	2867 and A, B, C, or D/80	2867 and A, B, C, or D/152	2434 and A, B, C, or D/80	2868 and A, B, C, or D/93	5619 and A, B, C, or D.
Max. Press.	1000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Rod Dia.	½"	1 1/16"	1"	1⅜"	1⅜"	1 15/16"	2"	2"	2⅞"	2½"	3½"	4"
Bore Area	·7854 □"	1·7671 □"	3·142 □"	3·142 □"	5·94 □"	5·94 □"	8·296 □"	12·57 □"	12·57 □"	19·64 □"	28·27 □"	44·179 □"
Rod Area	·1964 □"	·8866 □"	·785 □"	1·49 □"	1·49 □"	2·948 □"	3·142 □"	3·142 □"	6·492 □"	4·908 □"	8·296 □"	12·566 □"
Ann. Area	·5980 □"	·8805 □"	2·357 □"	1·652 □"	4·45 □"	2·992 □"	5·154 □"	9·424 □"	6·072 □"	14·727 □"	19·978 □"	31·613 □"
Max. Stroke	up to 6"	up to 40"	40"	40"	70"	70"	75"	80"	80"	100"	130"	144"

Note: 1. Longer stroke lengths are available for certain applications.
2. Cylinders can be manufactured to specific requirements.
3. Special rods are available.

THE RECOGNISED AUTHORITY ON HYDRAULIC POWER TRANSMISSION

For full details write to

KEELAVITE
Hydraulics

KEELAVITE HYDRAULICS LTD
ALLESLEY · COVENTRY · TEL: MERIDEN 441

KEELAVITE COMPLETE HYDRAULICS
— a complete range of units
— thirty years of hydraulic experience
— and a service that means success

Marketing

Industrial Development in Brazil

As the industrialization of the South American countries gathers momentum, an increasing number of concerns have shown interest in the initiation and extension of activities in this rapidly expanding market. To assist in the establishment of industrial ties with Brazil is the function of BRAZILIAN TRADE CONSULTANTS, who operate from 17, Farm Avenue, North Harrow, Middlesex, with Mr. G. B. Coleman as principal. The organization is associated with Administradores Profissionais Associados of Sao Paulo, Brazil, and their specialized services are offered to firms interested in having their goods manufactured in Brazil. Such arrangements may be made under a royalty agreement, in partnership with a local concern or by the establishment of a subsidiary company. Suitable licensees are sought and recommended and on completion of the agreement BTC continue to observe the operation to ensure that the client's interests are protected and the maximum revenue obtained. Assistance may also be rendered to companies producing capital equipment, who, whilst unable to manufacture locally, would welcome the opportunity of tendering for imported equipment.

The organization has already undertaken a number of licensing assignments, mainly for American, German and Italian firms. So far some 50 British concerns have shown interest or have agreements in various stages of negotiation. Amongst the industries undergoing most development are electronics and plastics.

Also in progress is an extensive road programme, always the forerunner of an upsurge in the activities of the many industries associated with and dependent on it. Vehicle production at present is around 12,000 units montly, the majority manufactured to foreign designs from locally produced components. As the interior is progressively opened up, this figure will become increasingly inadequate.

India's First Electronic Computer

Claimed to be the first electronic computer system to reach India, an IBM 1401 has been installed at the Bombay office of Standard Vacuum Oil Company. The system is attracting much attention abroad and is identical with one installed at the Cape Town office of the company's South African affiliate, Vacuum Oil Company. Following this, two more will shortly be installed in the Stanvac headquarters in Melbourne and Sungei Gerong, Indonesia.

The 1401 is a high speed CDP system said to be capable of reading information from 850 punched cards per minute, printing at 600 lines per minute and handling data from magnetic tape at a maximum speed of 2½ million digits per minute. Stanvac expect to gain much from the installation which, besides supplying constantly up-to-date essential records and control information, will act as a "guinea-pig" for the feasibility of using similar units in other company locations.

In accordance with their usual policy, Stanvac have designated natives of the countries concerned to be responsible for the operation of the systems. An Indian, an Australian and an Indonesian have been trained at the centre in New York before collaborating with IBM technicians in the installation of the systems in their respective countries. Two South African programmers were trained at the IBM Hamburg establishment in West Germany.

Marketing Agreement for Steel Containers

Following its diversification policy, FAIREY ENGINEERING LIMITED has entered into a manufacturing and marketing agreement with the FIRESTONE TIRE AND RUBBER COMPANY of Akron, Ohio. The agreement gives Fairey the sole rights in the UK for the Firestone range of stainless steel containers. Included are beer casks, pre-mix and post-mix beverage tanks and milk churns. Import and distribution are at present in progress with factoring to follow in the hands of a proposed separate subsidiary company.

Stainless steel beer casks offer distinct advantages over wooden or aluminium containers in that they require no lining material, and a quick steam wash renders the interior perfectly sterilized and chemically inert. Transportation is simplified by a two-thirds weight advantage over a wooden container and, most important of all from the consumer's point of view, the specially developed material is said to have no affect on the flavour, colour or brilliance of the beer. All seams are fusion welded.

The Fairey-Firestone containers, when available, will be cask or drum types with capacities ranging from 4½ to 18 gallons.

Eurotariff—a Guide to Exporters

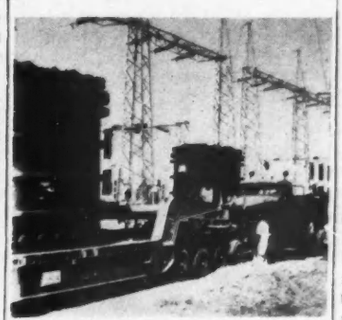
Manufacturers who are interested in developing their exports to the Common Market countries are faced with the complex problem of constant changes in the import tariffs. During the first half of 1961 more than 12,000 changes were made to individual tariffs. In addition, there is the question of nomenclature. The Common Market countries have adopted a simplified nomenclature (Brussels nomenclature) which telescopes some 8,000 previously existing items to only 3,000 items. However, the Brussels nomenlature differs from the existing national nomenclatures, and, therefore, during the period of transition before the common external tariff comes into force, the exporter must be able to identify his goods both under the Brussels nomenclature and the nomenclature of the individual Common Market country.

A new service, the Eurotariff (world distributors of this service are Creative Journals Limited, London, and the distribution in the UK is handled by Robert Lee and Company, 31 George Street, London W1) is a valuable guide for exports and firms which are considering branching out to the Common Market area. The service includes a reference book (over 800 pages) which tabulates all duties in force for each individual country of the Common Market for individual goods, and the tariffs in force for imports from member countries are published next to those in force for imports from countries outside the Common Market. The subscribers to this service are supplied with amendments—changes of applicable tariffs—and thus the reference book is always up to date.

Scope for Heavy Haulage Vehicles in Pakistan

A 75 ton 32 wheeled hydraulic suspension trailer made by CRANES (DEREHAM) LIMITED was recently shipped to West Pakistan.

Delivered in a dismantled condition to the Water and Power Development Authority, the trailer was assembled under the supervision of Mr. J. Rawlings, Cranes, works manager and used for the transportation of transformers and similar equipment for the West Pakistan grid system. Its first task was to carry a 45 ton transformer from Sarghoda to the grid station about



The Cranes 32 wheel trailer and the 45 ton transformer it transported to the West Pakistan grid station.

10 miles away. It then went on to Rawalpindi, a distance of 300 miles.

On his return Mr. Rawlings was enthusiastic about the growing demand for articulated road vehicles in West Pakistan. At the present time the majority of heavy transportation was undertaken by trail but rapid development in road construction was making long-distance road haulage a necessary and practicable alternative. With the prevalent high temperatures he emphasized especially the need for refrigerated vehicles.

Another Cranes trailer of 65 tons capacity has been ordered by the Malayan Electricity Board for operation in the Cameron Highland Hydro-electric scheme.

Russian Cars Use British Diesel Engines

The Belgian motor firm of Beheram-Demoen has placed an order with PERKINS ENGINES LIMITED for 500 diesel engines to be used in the Russian Volga six-seater saloon car.

The Belgian firm is assembling the cars in Antwerp under an agreement with the Russian manufacturers and this latest order for engines follows a previous substantial quantity requested in March.

The engine is the 1·6 litre 4·99 (4 cylinder, 99 cu. in capacity) developing 48 bhp at 4,000 rpm which has been used successfully in private cars exported to many parts of the world.

Besides their motor vehicle interests, Perkins are well known in the marine field and a new "baby" marine diesel engine has just been announced. Designated the 4.107, it has four cylinders and a capacity of 1·76 litres. Developing 36 shp continuously at 3,000 rpm with a maximum of 47 shp at 4,000 rpm, it is claimed to be well suited to a variety of craft, ranging from small cruisers to fast runabouts.

More Road Plant for the Argentine

In support of the extensive road programme now well under way in the Argentine, CHASESIDE ENGINEERING COMPANY have despatched a further five Loadmaster 1000 loading shovels to the province of Santiago del Estero.

The order is part of a £1½ million contract secured by Mercator SA of Buenos Aires, and Knowles and Foster, of London. A substantial quantity of similar equipment was recently shipped to the province of Neuquen.

New Communications and Automation Centre

SHIPTON AUTOMATION (SALES) LIMITED have opened a new centre at Africa House, Kingsway, London WC2, for the purpose of demonstrating office communications systems and equipment designed to automate office routine. Included in the display are a high speed automatic switch board, closed circuit television, a centralized dictation system, a transistor pocket-paging system allowing one-way speech, and an automatic telephone answering machine. Much of the equipment will be new to this country.

The "tele-check" display shows how a bank cheque may be projected by television to the clearing office and stamped with the cashier's initials by remote control without its leaving the counter. This system is said to be ideal for "drive-in" banks.

A most sophisticated automatic internal telephone system is the EDAS, a specialized miniature electronic computer which immediately dials the call between telephones connected to a private automatic exchange. By means of a button the caller selects the extension he wishes to reach and EDAS calls the exchange to test the receipt of the dial tone. This being established, an arithmetic unit then transmits the required dialling impulses. Finally the system logic brings the circuit into action.

Another demonstration of considerable interest is the television microscope. This works on orthodox television principles with the exception that the image when in electrical signal form is amplified with electronic aids prior to transmission, which may be over some considerable distance. Such a device must have a valuable potential for lectures as it facilitates "live" viewing of micro-slides, possibly transmitted straight from the laboratory.

The centre was opened by Major-General Sir Leslie Nicholls on 23 November and demonstrations can be arranged during business hours from Monday to Friday.

The 2-Rail Hornby-Dublo Train Set

A fascinating toy that is, surprisingly, a precision engineered product; backed by technical resources and made to compete successfully in a critical market.

THE Hornby-Dublo Train Set is a commercial product. As such it is the climax of a normal chain of engineering processes—research, design, testing and, above all, manufacture at an acceptable retail price—just like a motor car or a piece of industrial machinery.

But the enjoyable purpose that the train set and other Meccano products serve is undoubtedly good for the morale of the staff engaged in their production. The desire to bring pleasure to young people is latent in each one of us, so the toy maker has the advantage over manufacturers of more mundane pieces of equipment that in the fulfilment of his daily task he is also gratifying this natural instinct.

On the other hand, the importance of this factor should not be over-estimated. Like any other manufacturer, the toy maker has to try to look objectively at his market; he must first of all decide to which age group his product is primarily intended to appeal. If he decides to produce, say, rattles, then he knows that his potential market is no bigger than the number of very young children. If, on the other hand, he decides to go in for the more sophisticated kinds of toy, such as a train set, then he knows that his potential market is much bigger due to the much more diverse ages of children and adults likely to derive pleasure from it. Here the price factor plays a much more important part. Many toy trains and accessories are purchased by the youthful recipient, who is probably restricted by the amount of his pocket money.

The toy train designer has an exceptionally tricky set of conditions to reconcile before he introduces a new model. First and foremost he is tied by appearance. Probably model making is the only branch of engineering where the finished appearance conditions are so rigorous, since success depends upon realism. Meccano Limited wish it to be made plain that they are not model makers but toy makers; though when one is talking about toy trains as sophisticated as Hornby-Dublo, the line of demarcation which separates one from the other is purely a question of degree and many of the problems are common.

Reverting to the all-important question of appearance insofar as it affects a train set, a section of the toy maker's market would probably be happy with a circle of track and a simple free-lance vehicle that could be made to go fast, slow or stop by twiddling knobs; but such a set would have relatively little appeal unless the constituents of it closely resembled a train.

An important corollary is that the prime motive power must look like a full size locomotive—and not just any locomotive but one with sales appeal, of a well-known and popular class. In aiming his product at older children, the toy maker has unavoidably taken himself into the most discerning section of the toy market—those boys who, if the locomotive does not look quite right, may decide to buy from a competitor instead. So behind the tranquil scene of a boy playing trains lie a number of manufacturers actively competing with one another for his custom, using all the latest techniques and materials in order to keep down the selling price.

But the selling price is in turn a function of the realism. How faithfully then should the designer copy the full size rolling stock? In Hornby-Dublo, Meccano Limited have set their own standard for faithful reproduction coupled with moderate price. This standard has become sufficiently well established to lay down, perhaps subconsciously, broad definitions of realism even before the drawings are started.

TWO PARAMETERS

Two more strictly definable parameters next have to be settled; the scale, and the type of locomotive and carriages or wagons. The scale is determined automatically from the standard 00 track gauge, which measures approximately $\frac{5}{8}$ in between the rails, and Hornby-Dublo trains are about $\frac{1}{76}$th of full size. The gauge must be standardized for the sake of interchangeability of rolling stock and other accessories, since almost every model railway layout grows up in stages from a train set given as a present.

Deciding which particular full-size train to represent is not so easy ; but it is most critical since the whole project would fall through if the set possessed no sales appeal, however skilfully the finished appearance and the selling price are blended. A train set comprises a simple circle or oval of rails with a locomotive and carriages (or wagons) appropriate to the locomotive in terms of current railway practice. Usually one of Britain's named express trains is chosen, and Meccano Limited maintain close liaison with British Railways. There is a limit to the amount the toy maker can impose on the railway authorities, and a certain railway-mindedness in his organization is essential.

The choice of subject is governed finally by two factors:—

(1) regional considerations; the locality in which the train actually runs, and

(2) indications of preference from railway enthusiasts, in which letters sent to the *Meccano Magazine* play an important part.

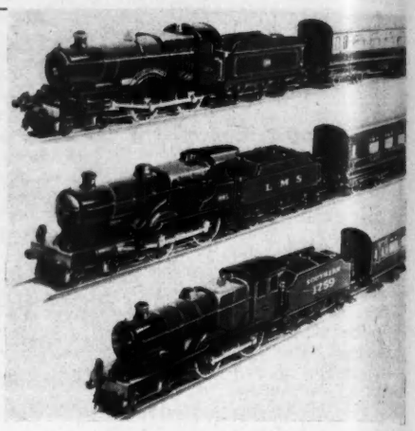


Fig. 3 Locomotives of three pre-war Guage 0 Hornby train sets.

The name Meccano Limited and Hornby-Dublo are well known, but how did it all start?

During the Victorian era children were not favoured toywise to the extent they are today. Frank Hornby was lucky to have a small workshop at his Liverpool home in which his spare time was spent in making small mechanical contrivances. A man of vision, he eventually became the inventor of Meccano, so well known that it is almost a household word which is often used to describe equipment with no connection whatever with Frank Hornby or his firm.

By the First World War Hornby had built up a sizeable factory in Liverpool turning out Meccano, and at the end of hostilities decided that the time had come to wrest the practical monopoly of the toy train market from Germany. The result was the famous range of Hornby Gauge 0 ($1\frac{1}{4}$ in) clockwork locomotives, train sets and accessories. Every detail was treated in true engineering fashion from the drawing office to the conveyor belts of the assembly lines on which the finished products took shape. The result was that some Hornby locomotives twenty or thirty years old are still running today.

The natural progression to electric drive using a third pick-up rail midway between the running rails occurred before 1930, and eventually most of the locomotives were offered in either clockwork or electric forms. But for the Gauge 0 trains the writing was on the wall. Smaller rooms for suburban houses, better electric motor

Fig. 1 (below) How the ring field motor is fitted into the 2-8-0 steam locomotive chassis.

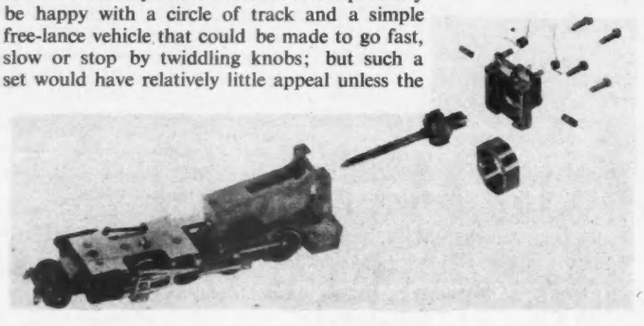
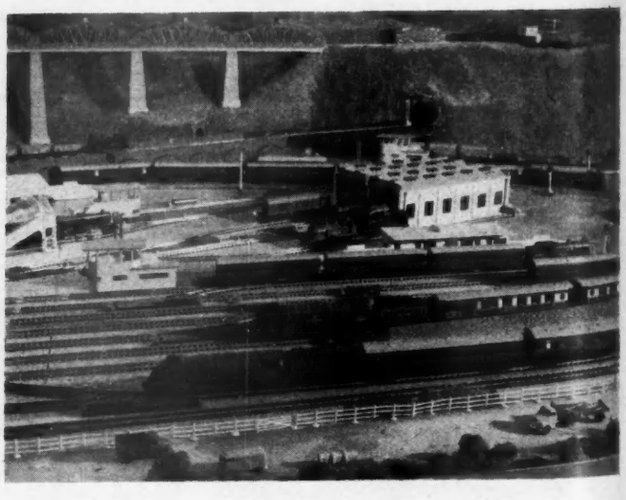


Fig. 2 (right) Part of Gamages' 1961 Christmas display.



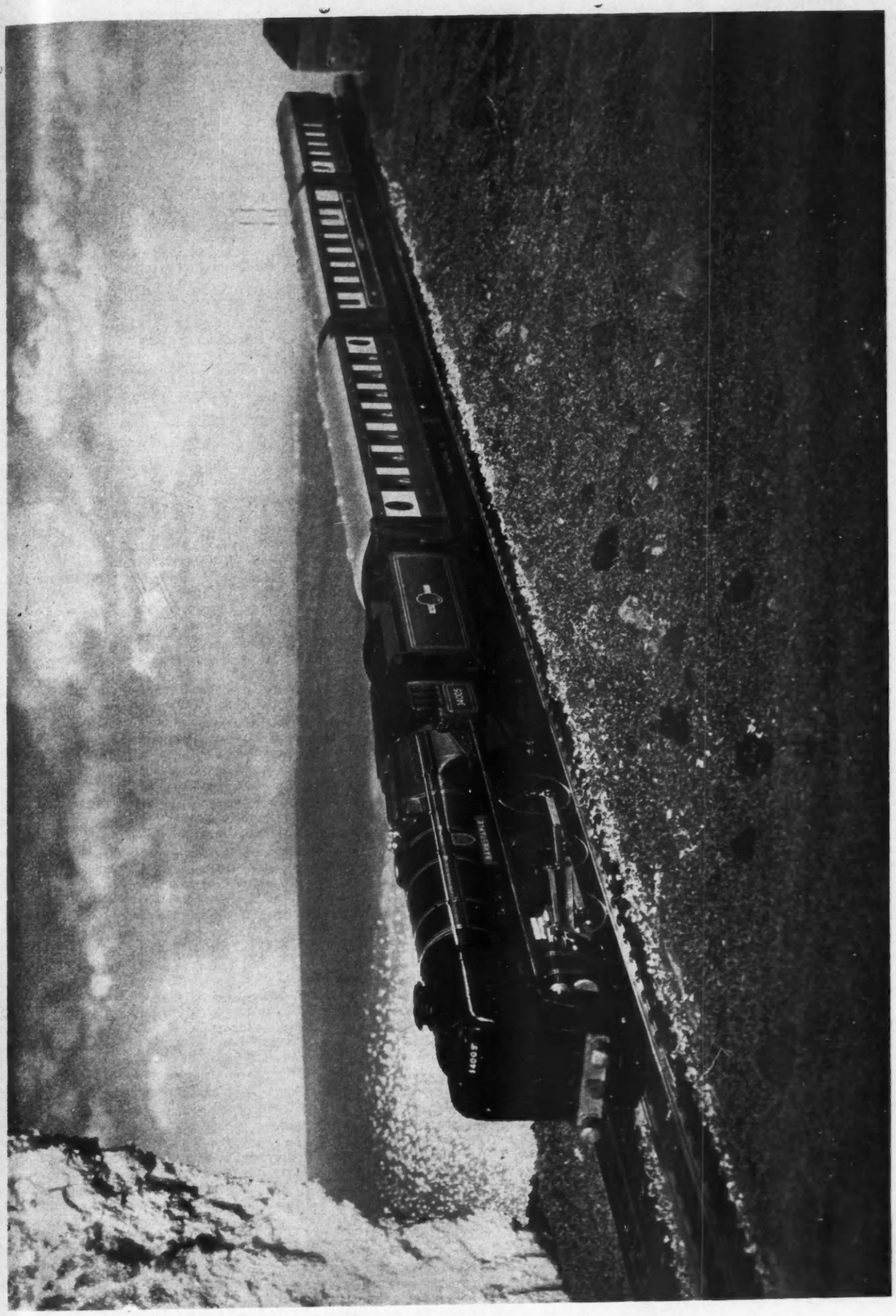


Fig. 4 Close attention to detail is a function of public demand and the manufacturer's personal pride.

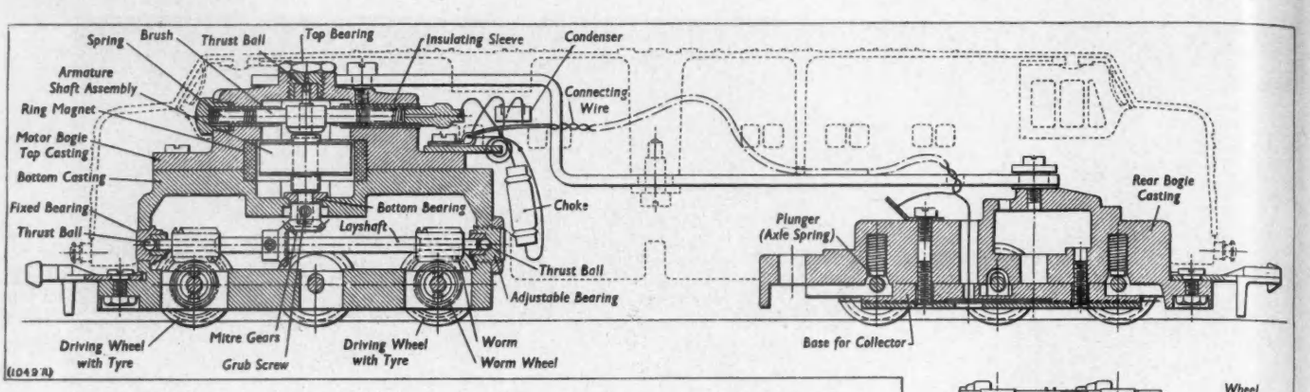


Fig. 5 Co-Co diesel with ring field motor.

techniques and the increasing need to reduce costs all pointed to a smaller " table top " train set ; and in 1938 Hornby-Dublo was born.

After the Second World War all Gauge 0 (except some of simpler clockwork sets for smaller children), and the clockwork Hornby-Dublo variant were abandoned in favour of extending and improving electric Hornby-Dublo. In 1959 the range of sets and accessories had become nearly as wide as the pre-war Gauge 0. There were 8 different locomotives, including the original 1939 model.

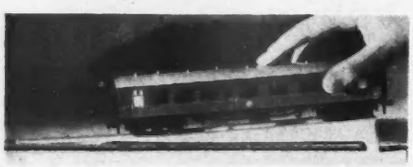
Though the 3-rail pick-up system possesses several technical advantages, the middle rail upsets the realism of the track. So just before Christmas two years ago the 2-rail Hornby-Dublo appeared, and it was an immediate success. Today, half the equipment sold is 2-rail, including the majority of train sets—but 3-rail is still popular and will remain so for many years due to the tremendous number of existing layouts.

In the 2-rail system, current is fed to the locomotive from one running rail through two or more wheels (the driving wheels in the case of a steam locomotive) in contact with it. The current is completed through the corresponding wheels and rails on the opposite side, one set being insulated from the other. Instead of having a plastic axle, in the Hornby-Dublo arrangement the axle is live with a spring-loaded pick-up plunger in contact with it, one of the wheels having a non-conducting centre.

The rails are of solid drawn nickel silver which possesses a high electrical conductivity and good non-corrosion characteristics. Both factors contribute towards eliminating irritating stoppages, and in the material specification the climates of other countries are taken into consideration. With the introduction of 2-rail, the pressed tinplate base printed to resemble ballast and sleepers was replaced by a moulded base incorporating individual sleepers. Apart from its better realism the 2-rail track combines quiet running with perfect insulation.

The range of locomotives produced at Liverpool now numbers twelve arranged for either 2- or 3-rail operation. Eight represent steam locomotives and four diesels, while Meccano (France) Limited produce a highly attractive French Railways electric locomotive, now available in Britain. Nine of the ten 2-rail train sets

Putting it on the track with a railer.



are offered at prices between £3 6*s* 0*d* to £7 4*s* 4*d* (excluding power unit/controller); and the latest set brought out earlier this year (shown in Fig. 4) is based on the Southern Region rebuilt West Country class locomotive " Barnstaple " and three Pullman coaches, at £9 18*s* 1*d*. The locomotive is fitted with the new ring field design of motor. The Pullman cars with polystyrene bodies have transparent windows and interior fittings and incorporate an exceptional amount of detail—a far cry from the printed tinplate of the Gauge 0 era, though this material is still sometimes used.

Adequate locomotive hauling power and speed characteristics are essential for success in toy railways. In order to please a wide variety of tastes, it is necessary to provide a top speed far in excess of scale maximum speed of the prototype. For the more particular user there is a power unit available with eight controller notches instead of four in either direction of travel and " pulse power " for creeping. Such considerations mean that the designer has to fit the largest possible motor within a space strictly prescribed in respect of size and shape by the locomotive outline. The detail design of the motor and gearing is tailored to each locomotive.

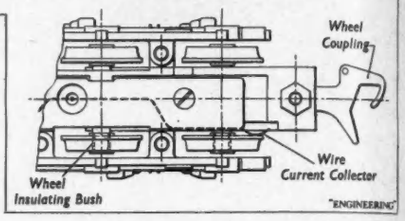
MORE POWER

Until recently Meccano always used a conventional horseshoe motor, but in developing the new diesels more power was sought. Since the double bogie arrangement introduced even more acute restrictions, the only course was to completely redesign the motor. The result of many months of research and development testing was the highly successful ring field motor, first introduced a year ago in the then new Co-Co diesel locomotive shown in Fig. 5.

As its name implies, the ring field motor has a permanent field magnet in the form of a solid ring, dispensing with pole pieces. Use of a tri-polar armature eliminates magnetic drag and magnetic lock, giving a consistently high torque at low speeds and making jerky starts impossible. A one-piece motor body die-casting offers protection of the moving parts against ingress of carpet fluff, always the bane of the motorized toy train designer, and also gives mechanical rigidity and quiet running. The high torque characteristic, coupled with the ability to use a $\frac{5}{8}$ in or $\frac{3}{4}$ in armature, gives the ring field motor powered locomotive a considerable load hauling advantage over one not so fitted, and also a longer life between overhauls.

During the past year two impressive demonstrations have been staged to prove the ring field motor's performance; in the first, a single Co-Co diesel locomotive succeeded in pulling a small boy on a special trailer, and in the second a similar locomotive hauled a train of 51 wagons continuously around a track until 100 actual miles (or 7,600 scale miles) had been covered.

At present, six Hornby-Dublo locomotives



are being fitted with the ring field motor and all new locomotives will be so fitted. From the production angle the ring field motor has the advantage of consistency of performance engendered by the virtual elimination of manufacturing inaccuracies of the kind that affect performance. Variation between the maximum speeds of different units, or of a single unit in which vital components have been changed, is within 5 scale mph. The air gap of 0·020 in is held within a total tolerance of 0·003 in and the maximum variation in magnet bore is 0·002 in.

These statistics show that the Hornby-Dublo train set is a precision engineered product of an organization with comprehensive and fully up-to-date manufacturing and testing facilities. One of the few complete sets of GPO standard testing equipment in existence is installed in Meccano's laboratory to ensure 100 per cent TV suppression. Safety is rightly treated with the utmost importance. The track and locomotives are adequately insulated for 12V operation and the power units, are double insulated.

Automation is a growing trend even in toy railways, and Hornby-Dublo accessories are on the market which enable practically every operation to be performed by remote control. Points and signal operation and even uncoupling (by means of an uncoupling rail) can now be carried out electrically.

Service is a tremendously important aspect—who has not at one time or another in his life packed up a beloved locomotive and despatched it to Binns Road, receiving it back a few days later with its " works," as good as new? At present all service is handled by a branch factory at Aintree, but arrangements are in hand for 80 selected dealers up and down the country to start doing this work themselves.

The present day tendency towards smallness has doubtless been encouraged by the rapid development of moulded plastics, which can be used to show such a wealth of detail. Dinky toys using a cast zinc-based alloy, have repeated the performance of Meccano and Hornby trains to become pre-eminent in their field. They stemmed originally from life-size figures produced in conjunction with toy railways.

In the field of making toys, the public are the final arbiters; their desires alone set the pace and dictate the course. The manufacturer of serious toys has almost every household in the world as his potential market so long as he correctly directs his technical assets.

Meccano Limited, Binns Road, Liverpool 13.

New Application for Thermoelectricity

A thermoelectric generator, developed by the Westinghouse Electric Corporation, USA, has been put into service to protect a mile-deep gas well belonging to the El Paso Gas Company, Texas. Installed in a remote region of the San Juan Basin, New Mexico, the generator supplies the electric power needed to prevent corrosion of the well's steel casing.

The anti-corrosion technique, known as cathodic protection, keeps the casing from being eaten away through an electrochemical reaction which occurs spontaneously in metal objects buried in the ground. The thermoelectric generator taps a small amount of the gas coming from the well, burns it, and converts the heat directly into electricity.

According to Dr. R. A. Ramey, director of the Westinghouse new products laboratory, this is an excellent example of the possible applications of thermoelectricity. " A thermoelectric generator has no moving parts. It is a simple, trouble-free, static system ideally suited to power production in remote areas where routine maintenance of equipment is especially difficult. We can expect to see thermoelectric power increasingly used for such applications, both industrial and military," said Dr. Ramey.

The thermoelectric generator is connected between the 5,000 ft gas well casing and a ground bed consisting of silicon cast iron anodes packed vertically in a hole of 200 ft depth. It reverses the normal flow of current set up by the casing as it chemically reacts with the soil. Thus, the easily replaceable ground bed, instead of the steel casing, is slowly eaten away.

Protection of the well casing is accomplished with about six amperes of current at eight volts dc. This power is generated at a temperature of 800° F on the hot side of the generator. The cool side of the unit operates at 200° F, higher than the boiling point of water at the 6,100 ft elevation at which the generator operates.

The installation of this thermoelectric system forms part of a cooperative programme between Westinghouse and El Paso Gas, to evaluate this new method of power generation for gas well and pipeline protection.

Nuclear Generator for Satellites

The second successful use of atomic energy in space was recently confirmed when nuclear powered signals were picked up from the US Navy's Transit 4B satellite, launched from Cape Canaveral on 15 November. The radioisotope-fuelled SNAP generator furnishing electricity to transmitters and instruments aboard this navigational satellite is similar to a unit which has been supplying continuous power to Transit 4A since last June.

Designed and built for the US Atomic Energy Commission by the Martin Company's Nuclear Division, the SNAP unit weighs 4·6 lb. It provides 2·7 watts of continuous power from its nuclear fuel, which is sealed inside a container sturdy enough to survive any mishaps that might occur during launching.

The grapefruit-sized atomic generator aboard Transit 4B converts heat from the spontaneous decay of about 95 grams of non-fissionable plutonium-238 directly into electrical energy without moving parts. With its accompanying equipment, it comprises a complete power system, supplying correct output voltages to the satellite's instruments and two of its four transmitters.

Apart from generating power continuously for years and eliminating much circuitry, the SNAP atomic power source does away with the need for heavy rechargeable batteries.

The reliability of such generators has been demonstrated by over 8,700 watt-hours of energy provided so far by the first SNAP, which was put into orbit on 29 June, 1961.

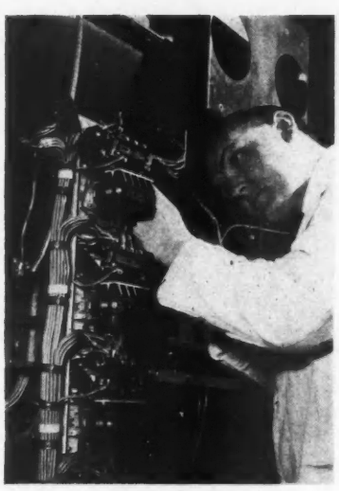
The Martin Company has been carrying out extensive analyses and tests for the US Atomic Energy Commission since it unveiled a proof-of-principle SNAP generator at the White House in January, 1959. These studies have resulted in a series of developments related to the safe use of atomic devices in space.

When these atomic units re-enter the atmosphere, they will disintegrate into particles about one-millionth of an inch in diameter. At ground level, the amount of radiation added by the generators will be so small as to be indistinguishable from that occurring naturally. An extensive further programme is now being conducted to ensure that larger, more sophisticated nuclear generators and reactors can be launched into orbit as safely as the Transit units.

Preparing for Satellite Communication

Standard Telephones and Cables Limited have been awarded a contract for the supply of a transmitter for use by the GPO in satellite communication experiments to be carried out next year in cooperation with the American authorities.

The equipment will be installed in a room built into the 85 ft diameter steerable aerial now being erected on a site at Goonhilly Down, Cornwall. The transmitter will operate in the 2,000 Mc/s band, and will deliver a frequency-modulated output of 10 kW. Additional items to be supplied by S.T. & C. include power equipment for the transmitter and a water-to-air heat exchanger unit.



A transmitter is being prepared in Cornwall for experimental satellite communication with the USA by April, 1962.

The present programme calls for the whole transmitter to be installed on site and fully operational by April, 1962. An active repeater communication satellite to be launched by the USA authorities will enable tests to be conducted on television transmission and two-way speech communication between Cornwall and the American ground station at Rumfrod, Maine.

Constant Rate Stroboscope Unit

Stroboscopes are in very wide use nowadays for the observation of cyclic events which are too rapid to be followed by the unaided eye. If the stroboscope flash rate equals the repetition rate of the event being observed, it appears to be " frozen," while a slight difference in rates results in an apparent slow motion.

With a steady repetition rate, both effects are easy to achieve, but where it varies, it is often impossible to keep the stroboscope in step by manual adjustment of the flash rate. This problem is particularly acute when carrying out resonance tests on a vibrating table.

A new instrument, developed by Dawe Instruments Limited, Western Avenue, Acton, and known as Type 1208 Variphase strobe unit, can be used to overcome this difficulty.

The instrument can be preset to give any desired frequency difference between 0 and 1·5 c/s, which is maintained irrespective of the true drive frequency. The unit is fed from the oscillator driving the vibrating table, accepting any signal from 3 to 30V rms and from 5 c/s to 5 kc/s. When set to zero, the unit triggers the stroboscope lamp (or lamps) at the input rate to provide a frozen image.

A continuously variable phase shifter on the front panel, calibrated from 0 to 360°, enables the item under observation to be studied at any point in the cycle. The phase shifter can also be driven by a variable-speed electric motor at any speed up to 1·5 complete revolutions per second, thus providing any desired frequency difference up to 1·5 c/s. Automatic frequency dividers are provided to prevent damage to stroboscopes with low operating limits.

The unit can also be used for the optical calibration of vibration pickups, or to provide a sine wave signal of calibrated continuously variable phase from a single phase sine wave input.

Saline Water Purification

Two new technical reports on the topic of saline water purification have been published and are for sale by the US Department of Commerce, Department of the Interior.

The reports are: "A New Process for the Production of Fresh Water from Sea Water" and "Investigation of Supersaturation in Saline Water Conversion."

The first report was prepared by the Struthers Wells Corporation, Warren, Pennsylvania, and by the Scientific Design Company Incorporated, New York City. This is the first published report on the Struthers Wells-Scientific Design freezing process. The process employs direct contact between saline water and a hydrocarbon refrigerant. It differs from other freezing processes principally in using techniques of controlled crystallization to produce large, uniformly sized and regularly shaped pure ice crystals.

The experimental programme conducted by Struthers Well and Scientific Design has confirmed that uniform crystals of pure ice, approaching 1mm in diameter, can be frozen from sea water under properly controlled conditions. These crystals were easily centrifuged and washed to a purity better than the target objective of 500 parts per million of salinity.

The second report: "Investigations of Supersaturation in Saline Water Conversion", which was prepared by Ionics Incorporated, Cambridge, Massachusetts, has as its preliminary objective determination of conditions which control the allowable level of supersaturation of calcium sulphate in the waste stream of electrodialysis demineralisers.

Electrodialysis equipment operates by transferring salts from the main product stream into a waste, or disposal, stream. The minimum relative volume of the waste stream is determined by the maximum permissible salt concentration in this stream.

Copies of these reports are obtainable from the Office of Technical Services, United States Department of Commerce, Washington 25, DC. The price of the first report is $2.25 and the other is $1.50.

An Ultrasonic Flowmeter for Industry

Industrial engineers are constantly beset with the problem of measuring fluid flow accurately. An ultrasonic instrument, which could go a long way toward overcoming the problem, has been developed by the British Scientific Instrument Research Association.

THE concept of the ultrasonic flowmeter has been known and talked abour for several years now but, so far, few attempts have been made to produce a practical and commercially viable instrument. In fact, no British manufacturer has yet placed one on the market.

At the British Scientific Instrument Research Association, work on ultrasonic flow measurement has been in progress for more than four years now, and has led to the development of a device which could be of considerable value to industry. Laboratory work on this instrument, which culminated in the production of a well-engineered prototype model some two years ago, has been taken up by Bailey Meters Limited, Croydon, Surrey, who should eventually produce a commercial model. Much of the development work has been under the sponsorship of the National Research Development Corporation.

The SIRA instrument has been successfully calibrated at the National Engineering Laboratory and experimentally tested under conditions of turbulent flow at the Grove Road Power Station, London. A comparison examination, lasting 9 months, has also been made against orifice plate measurement at ICI, Billingham, with very good results.

Advantages of Ultrasonics

The ultrasonic device has one major advantage over most other flowmeters in that it does not constrict flow. This means that it is free from the problems of corrosion, gelling and accumulation of suspended particles. In theory, there are several other advantages. Firstly, it does not introduce a head loss, thus saving in pumping energy. Secondly, surging or overload cannot damage it since it is not in the path of flow. Finally, since it has no moving parts, it is potentially a fast response device and should present no problem in the measurement of pulsating flow.

Of course, most of the above advantages are also possessed by the electromagnetic flowmeter, and it is therefore not suggested that the two devices should compete. Instead, they should be complementary, each having its own area of optimum use. In particular, the ultrasonic flowmeter can be used with materials whose resistivity is too high to be responsive to electromagnetic measurement.

An ultrasonic flowmeter was developed and marketed in the USA several years ago, but met with little success in industry. This device was based on an instrument for measuring flow during air-to-air refuelling, where the flow rates are very high. However, with the lower flow rates normally encountered in industry the problems of measurement are much greater. For this reason, several techniques have been suggested to improve on the basic concept of ultrasonic measurement.

The SIRA technique appears to have overcome the errors inherent in the earlier devices and there seems to be no reason why it should not work to within one per cent error at normal rates of flow. It is basically aimed to work at lower flow rates, of the order of five feet per second, in pipes ranging from 1 to 12 in in diameter.

The Main Problem

One of the main difficulties experienced in designing an ultrasonic flowmeter is in making the instrument independent (or virtually so) of variations in the velocity of sound through the metered fluid. The SIRA research team have gone a long way toward devising a way of meeting this requirement, and it is in this respect in particular that their instrument shows merit.

Basically the principle of the ultrasonic flowmeter is simple. Fig. 2 shows a basic version, in which two pairs of ultrasonic transducers are inserted into the pipe. Electrical pulses fed into the transmitting transducers (T_1 and T_2) cause corresponding pulses of sound to be radiated into the liquid. These pulses travel out at the speed of sound, c, through the liquid until they impinge upon their respective receivers (T_3 and T_4) where they are transferred into electrical pulses and fed to the detecting equipment. If the transducers are spaced by distance l the time of transit will be $t = \frac{l}{c}$

When the fluid is flowing with velocity v the pulses in one direction will be delayed slightly in transit, and the others will be speeded up. The new transit times will be

$$t_1 \doteq \frac{l}{C + \text{Cos } \theta v}$$

and

$$t_2 = \frac{l}{C - \text{Cos } \theta v}$$

The difference in arrival times will be

$$\Delta t = t_2 - t_1 \doteq \frac{2l \text{ Cos } \theta v}{C^2} \qquad (1)$$

where $\cos \theta v \ll c$ (velocity of sound is normally about 1,500 metres per second).

Instead of using pulses, continuous signals of frequency f may be used, in which case the phases of the signals at the receivers will diverge under the influence of flow. The phase difference will be

$$\Delta\phi = \omega \Delta t \doteq \frac{2\omega l \text{ Cos } \theta v}{c^2} \qquad (2)$$

where $\omega = 2\pi f$.

There would be very little difficulty in measuring flow by ultrasonic techniques if it were not for the fact that the velocities of the sound waves are affected by factors other than the fluid flow—particularly temperature. This means that a technique is required of using the sound waves in such a way that the information obtained is as near as possible independent of the sound velocity. This is, in fact, what the SIRA research team have largely succeeded in doing.

SIRA Technique

Fig. 3 shows the basic form of the SIRA arrangement. Transducers T_1 and T_2 transmit and receive sinusoidal signals to and from each other. Their signals frequencies, f_1 and f_2 respectively, are each in the ultrasonic range (about 5 Mc/s), the two differing by about 500 c/s. Since the two signals travel the same path, any changes in the sound velocity, c, are the same for each of them.

At first sight, it does not seem possible that any minute differences between the velocities of sounds taking slightly different paths in the same fluid could affect the final outcome substantially. However, although the resultant variations in c might be very small, the derivation of equation (2) indicates that they could well be of the same order as the rate of fluid flow.

When the instrument is in use, each transducer crystal has two signals impressed upon it, one from its respective signal generator and another received through the fluid (containing information about the rate of fluid flow). By mixing the two signals that appear on each transducer, it is possible to obtain two sets of difference frequencies, $f_1 - f_2$. These two resultants will differ from each other in phase relationship in a manner that corresponds to the time difference between the sound travelling in the direction of flow and the sound travelling in the other direction, thus enabling the flow rate to be deduced.

In order to obtain a maximum degree of accuracy, the resultant phase difference must be as high as possible, but it must not exceed 360° if ambiguities are to be avoided. Equation (1) shows that this dictates the frequency of the sound waves so that, for most purposes, a frequency of range about 500 kc/s to 5 Mc/s is required.

Refraction Transducer

By making the two sound signals travel the same path, errors which would rise due to variations in c along different paths are elimin-

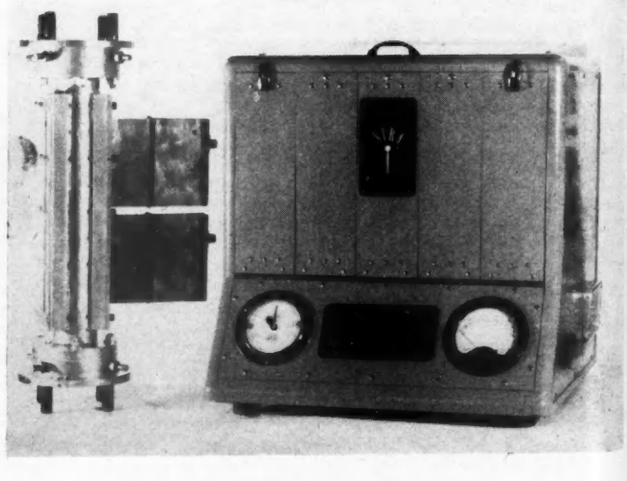


Fig. 1 A well-engineered prototype model of the industrial ultrasonic flowmeter has been produced at the SIRA laboratory. A typical 2 in pipe unit is shown on the left of the picture.

Research Report

on work of the

British Scientific Instrument Research Association, South Hill, Chislehurst, Kent.

Director
J. THOMSON, M.A., D.Sc., F.INST.P., M.I.E.E.

Head of Electronics Department
R. E. FISCHBACHER, B.Sc., A.R.S.C.T., A.M.I.E.E. (Assistant Director).

ated. However, c may still vary with temperature and fluid composition in a manner that is not in sympathy with the flow rate, so that further precautions are required in order to achieve a high order of accuracy. In the SIRA instrument, this is done by adjusting the refraction angle of the sound beam, see Fig. 4.

The transducer housing is mounted on the pipe at an angle ϕ, which can be varied over a limited range. If no refraction occurred, the sound wave would continue across the pipe of angle ϕ, with a velocity c and a path length 1. However, due to refraction at the interface (caused by sound velocity changing, to c') between pipe and fluid, the angle is changed to θ, and the path length becomes $1'$. By carefully choosing angle ϕ, the ratio of path length to sound velocity can be made fairly constant, so that errors due to fluctuations in sound velocity are minimized.

This technique has made the instrument self-compensating over variations of about $\pm$ 5 per cent in c, which corresponds roughly to variations of 40° C in the temperature of water.

Angles of refraction greater than 45° can be obtained by suitable choice of transmitting materials and by using shear waves instead of compression waves. Suitable materials are: noble metals, tin, lead glass, and certain liquids.

Phase Stability

Since most of the circuits in the SIRA instrument operate at about 400 to 800 c/s, phase stability problems are easily overcome by using wide-band circuits. However, there are still some circuits tuned to high frequencies and considerable attention must be paid to ensure that these do not suffer from phase shifts. The main precautions that have been taken against this are: (1) All L to C ratios are kept small so that the effects of stray valve capacitances are minimized; (2) the mechanical stability of coil cores and capacitors is kept as high as possible (temperature compensation has not been found necessary); and (3) the thermal environments of the two transducer circuits are maintained closely to each other so that temperature drifts are in the same direction and therefore cancel. The oscillator crystals themselves are placed side by side.

Use of Doppler Effect

Although the research team at SIRA succeeded in developing an ultrasonic flowmeter to an advanced stage some two years ago, they are still continuing their work on flow measurement by ultrasonics. Their latest development in this context is an instrument using the Doppler effect, which has now reached the stage where it can be considered for practical applications.

This method of metering the flow of a fluid involves measuring its mean velocity in the pipe or conduit. Ultrasonic vibrations of fixed frequency are radiated into the fluid from a transducer, while another transducer receives energy scattered from the moving fluid. Because of the Doppler effect, the relative motion between the fluid and the transducer causes the received signal to consist of a band of frequencies shifted from the transmitted frequency.

The mean shift has been found to vary in a linear fashion with flow and is also proportional to the operating frequency. Thus, the basic requirement of the fluid to be metered is that it contains suitable scattering elements. Such elements may be solid particles or gaseous bubbles.

The operating frequency is determined by the fluid velocity and the size and concentration of the scattering elements. For low concentrations of scattering elements their size must be of the same order as the wavelength of the sound in the fluid. The wavelength decreases linearly with increase of frequency; for most fluids it is of the order of 300 μm at 5 Mc/s. At this frequency, it has been found possible to meter flows with mean velocities down to about 0·1 metres/sec.

The chief advantage of this flowmeter is that it presents little or no obstruction to the fluid flow. Indeed it has been found possible in some circumstances to estimate flow with transducers wholly external to the pipe.

In principle the meter should work on any size of pipe, and flow rate: in practice, consideration must be given to the factors above, and the transducers to be employed. The flowmeter is capable of monitoring flow rates in open conduits; in this case small transducer probes are inserted in the fluid.

The transistorized instrument which has been developed is comparatively small and completely self-contained. The expected accuracy depends on the application and is likely to be in the region of a few per cent.

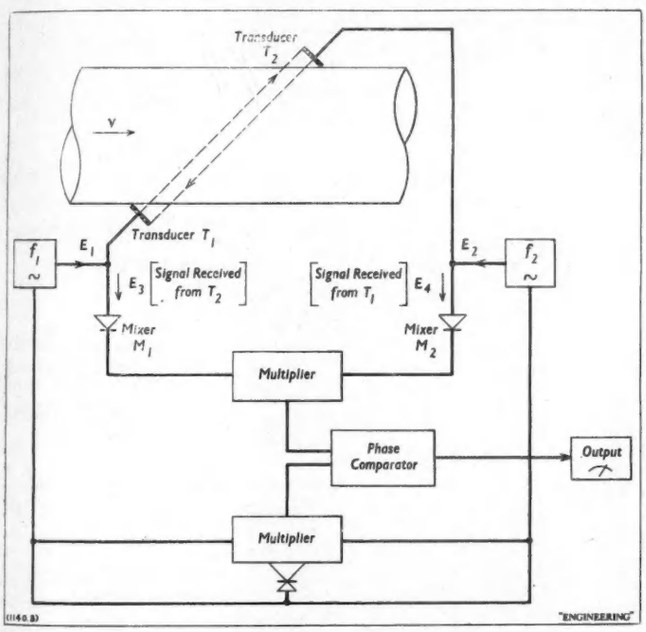
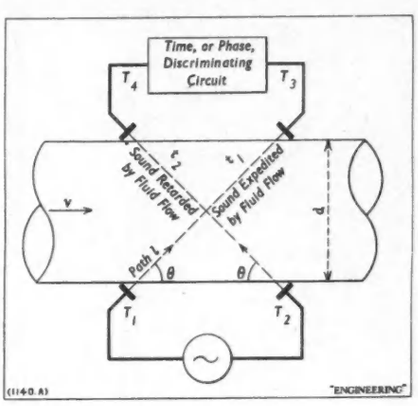
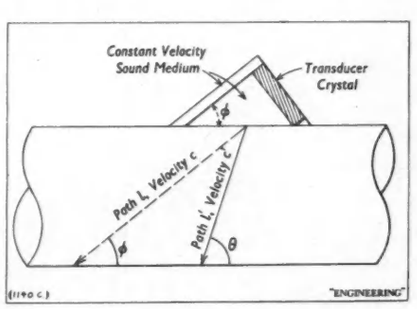


Fig. 2 (upper right) Sound waves passed through the fluid in the direction of flow will be increased in velocity, while those passing in the other direction are slowed down.

Fig. 3 (left) In the SIRA instrument, the sound waves are made to travel along the same path. Phase discrimination is used to determine the velocity difference.

Fig. 4 (lower right) By adjusting the refraction angle of the sound beam entering the pipe, variations in velocity through the fluid are minimized.





Measurement of Ships' Speed by Radar

Scientists at the British Shipbuilding Research Association are working on a new method of measuring ship speeds which might eventually provide an acceptable alternative to the present measured mile tests.

Speed is measured by radar carried on the ship, using a buoy as a datum point. The buoy, which is put over the stern of the ship, can either be small and free-floating, or a larger, moored type; but the former is expected to offer the most advantages. Radar signals from the ship are reflected by the buoy.

Before the new method could be developed to its present stage, it was necessary to evaluate the behaviour of buoys in the wake of a ship, and tests have been conducted by BSRA with the cooperation of Shell Tankers Limited, Shell Research Limited and Hunting Surveys Limited.

In the trials, a pattern of buoys was laid in line with measured mile beacons and the Shell tanker Aluco (18,750 tons deadweight) ran through the centre of the pattern. An aircraft was then used to photograph the buoys at two minute intervals to record their movements.

One particularly interesting feature of the tests was the discovery of a larger degree of eddying and turbulence than was anticipated. It is possible that these might have an important bearing on the performance of a ship in measured mile tests, and further studies are being made.

If successful, the new technique will have many advantages. For instance, speed trials could be conducted anywhere in open waters, thus obviating the need to send ships to one of the few areas where there are measured mile beacons. This would lead to substantial savings in both time and money; apart from fuel and other operating expenses, extra insurance can be a considerable item when a loaded ship is diverted for speed tests. It would also facilitate tests with dry-cargo ships in a fully loaded condition.

Another advantage is that there would be no need for ships to go close in shore, so that results could be obtained in the deep-water conditions encountered in actual service. Eventually, the new method might be developed so that it could be used to calibrate ship's logs to enable masters to undertake accurate speed checks under various conditions along their normal trade routes.

Smoke Trouble

IT LOOKS as if householders are likely to be bothered with two forms of smoke trouble this winter. There is the perennial one of the chimney that leaks smoke into the room, and now there is the limitation on the amount of smoke that can be let out, for the smokeless zones are being steadily extended.

Smoke control is an undoubted boon to health but is a nuisance to burners and suppliers of solid fuels. (Incidentally, oil is not quite exempt from blame as a smoke producer; a wrong adjustment can produce some of the thickest black smoke known, the sort used for smoke screens.) In fact the only fuel that is exempt from reproach is gas because, to be pedantic, electricity is not a fuel.

The problem for the coal board is that raw coal is one of the worst offenders for smoke and the alternatives—coke or premium smokeless fuels—have not achieved great popularity with the general public. One reason may be that both are more expensive than coal, although it has been pointed out that, since there is less waste, the cost of the heat actually available is not much different. Coke is distrusted because of smell and both are unpopular because they fail to have the " life " in them that exists in a good blaze of coal. The availability of the smokeless fuels has also been limited.

Consequently it is not surprising that there has been a distinct swing to gas or electricity in those areas where smoke control is in force, though as Dr. Hill, now Minister for Housing and Local Government, observed recently to the Coal Industry Society, the intention to change may have been there already, and only the excuse was wanting. He also pointed out that the feeling against coke on account of the alleged smell was largely prejudice: any fire would smell if the chimney were blocked. The difference was that a coal fire would make the trouble known by the smoke.

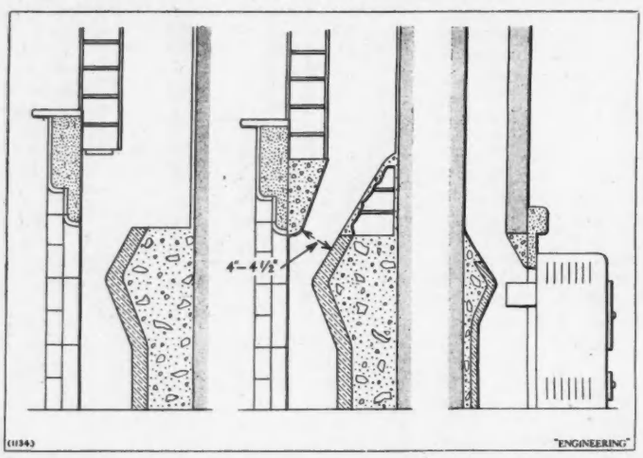
Where smokeless zones have been declared, it is possible to obtain grants of up to 14*s* in the £ for the installation of approved appliances; the grant also extends to gas pokers or electric lighters. Information and lists of approved appliances can be obtained from the Coal Utilisation Council, 3 Upper Belgrave Street, London SW1, or approved agents; from the Smokeless Fuels Federation, 74 Grosvenor Street, London W1; or the Womens Advisory Council on Solid Fuel, 18 South Moulton Street, London W1.

Cures for the first of the two chimney troubles are suggested in a little booklet issued by the Coal Utilisation Council entitled *Curing Chimney Troubles*. " Smokiness," says the booklet, " is seldom due to a faulty appliance; most frequently the cause is either poor chimney design and construction or unfavourable site conditions," and then goes on to consider the different shortcomings.

Four main symptoms are listed, and it is interesting to note that the blowing back of some, but not all, fumes and smoke, regardless of the weather conditions, can be attributed to insufficient draught caused by too large a chimney opening. An example of such a condition and its cure is shown in the first two sketches. Fitting an adjustable throat restrictor is an advantage, as then the opening can be set wide to light the fire and later closed to suit the change in " pull " as the chimney warms up. Bad fixing resulting in poor draught is shown in the third sketch—the remedy is obvious.

It should also be remembered that sealing the doors and windows of a room to prevent draughts on the occupants also prevents the entry of air to keep the fire burning. With a suspended floor (boards on joists) a possible solution is the installation of extra air inlets drawing from below the floor boards; with solid floors, such inlets must be fitted in the walls of the room which is seldom as satisfactory.

Poor updraught is the commonest reason for smoky chimneys but the causes are many. Too large a chimney opening and too little air entering the room have already been mentioned. Other causes listed in the booklet are partial blockage due to fallen mortar; unsuitable size of flue; badly fixed liners; and unsuitable chimney pots. In each case a remedy is suggested. Air leaking into the flue at some point can also reduce the effective draught and there are methods for locating the trouble spot.



The first two sketches show a cause of poor draught, due to too much air passing up the chimney, and its remedy. Alternatively an adjustable throat restrictor could be fitted. The third shows how bad fixing can produce bad draught: the remedy is obvious.

The second symptom in the list is no updraught at all, which is a fairly sure sign of a blocked chimney; the remedy is to locate the block and remove it—often necessitating opening the stack. A really cold flue can also produce the same lack of draught and a quick test should be made with a piece of lighted newspaper. The third symptom is when the smoke is definitely blown back into the room in a steady stream. This trouble, and the fourth, smoke being blown back intermittently, are difficult to cure and are due to the top of the pot being in an area of high pressure or the air inlets to the room in one of low pressure. Both causes are usually connected with the wind in a particular quarter and can often be cured by extending the chimney above the area of high pressure (normally by extending it above the ridge of the house) or by keeping outside doors and windows closed on the lee side of the house. Opening a window on the windward side will often cure the trouble and is one test to prove the diagnosis.

Many types of suction-inducing cowls have been designed to assist in overcoming these two conditions and some are effective even when the wind is blowing directly down on the chimney as, for example, when the latter is situated in the lee of a tall building. Several are illustrated in the booklet. Sometimes however the only satisfactory remedy is to change the appliance to one requiring a smaller draught—for instance by replacing an open fire with a closed stove.

ENGINEERING

Published every Friday by Engineering Ltd., at 36 Bedford Street, London WC2, England.
Telephone: Temple Bar 3663.
Telegrams: Engineering Lesquare London.

Chairman
J. A. Dixon, M.A., A.M.I.Mech.E.

Editor
F. B. Roberts, M.B.E., M.I.Mech.E.

Deputy Editors
D. Fisher, Ph.D., B.Sc., A.M.I.C.E., A.M.I.Mech.E.
A. A. H. Scott, B.Sc., A.M.I.Mech.E.

Department Editors
Book Reviews and At Home
A. A. H. Scott (Deputy Editor)
Construction
D. Fisher (Deputy Editor)
Design
J. T. Godfrey
Companies and Events in Advance
J. E. Dodsworth
Marketing and Automobile Review
J. L. Tosen
Metals and Materials
D. C. E. Gribble, B.Sc.
New Plant and Equipment
C. R. H. Simpson
Product Profile
K. M. Brown
Production and Human Element
G. T. Page, M.A.
Research
R. A. Coffee, D.I.C., A.M.Brit.I.R.E.
Special Articles
P. B. Jones

SUBSCRIPTION MANAGER
G. A. Roberts

ADVERTISEMENT MANAGER
G. H. Dixon, M.A.

Contributed Articles
Notes for the guidance of contributors are available from the Editor. Contributed articles usually carry the author's name when published; they should be exclusive to ENGINEERING. When an article is accepted for publication the author is normally advised of the planned publication date.

Subscription Rates
One year, inland and abroad £5 10*s* (Canada, £5 5*s*). Three months 27*s* 6*d* all countries. Single copies 2*s* 7*d* post paid.

Back Numbers
Back numbers, from recent issues to certain of the earliest issues from 1866, are available at the usual price for single copies.

Reprints
Reprints of articles which have been published in ENGINEERING can be supplied. Requests for quotations, stating the quantity required, should be addressed to the Reprints Department.

Engineering Information Service
Assistance is available from Engineering Information Service in obtaining information, and in locating sources of information, both technical and commercial. EIS deals, for example, with names of makers and suppliers of plant and equipment, technical data on design, markets for engineering products, and the compilation of references to information on specific topics. Inquiries should be addressed to Engineering Information Service, 36 Bedford Street, London WC2.

Advertisement Rates
The rates for advertising in the classified advertisement sections (Appointments, Company Meetings, Trade and Technical) are given in those sections. The Rate Card, covering all advertisements including display, is available from the Advertisement Manager.